NASA SP-7037 (330)
May 1996

# AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES


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# Introduction

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Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

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# Table of Contents

Records are arranged in categories 1 through 19, the first nine coming from the Aeronautics division of *STAR*, followed by the remaining division titles. Selecting a category will link you to the collection of records cited in this issue pertaining to that category.

# Indexes

Two indexes are available. You may use the **Find** command under the **Tools** menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.



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# Appendix

Select **Appendix** for important information about NASA Scientific and Technical Information (STI) Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

# Typical Report Citation and Abstract

**ON MICROFICHE**

↓

**ACCESSION NUMBER →** **N96-10751#** Sandia National Labs., Albuquerque, NM. ← **CORPORATE SOURCE**

**TITLE →** **Minimizing phylogenetic number to find good evolutionary trees**

**AUTHORS →** Goldberg, Leslie Ann; Goldberg, Paul W.; Phillips, Cynthia A.; Sweedyk, Elizabeth (California Univ., Berkeley, CA.); and Warnow, Tandy (Pennsylvania Univ., Philadelphia, PA.) ← **AUTHORS' AFFILIATION**

**PUBLICATION DATE →** 1995 26 p Presented at the 1995 Symposium on Combinatorial Pattern Matching, Helsinki, Finland, 4-7 Jul. 1995 Sponsored by California Legislative Grant

**CONTRACTS/GRANTS →** Contract(s)/Grant(s): (DE-AC04-94AL-85000; NSF CCR-94-57800)

**REPORT NO.(S) →** Report No.(s): (DE95-011893; SAND-95-0831C; CONF-9507123-1) Avail: CASI HC A03/MF A01 ← **AVAILABILITY AND PRICE CODE**

**ABSTRACT →** Inferring phylogenetic trees is a fundamental problem in computational-biology. We present a new objective criterion, the phylogenetic number, for evaluating evolutionary trees for species defined by biomolecular sequences or other qualitative characters. The phylogenetic number of a tree T is the maximum number of times that any given character state arises in T. By contrast, the classical parsimony criterion measures the total number of times that different character states arise in T. We consider the following related problems: finding the tree with minimum phylogenetic number, and computing the phylogenetic number of a given topology in which only the leaves are labeled by species. When the number of states is bounded (as is the case for biomolecular sequence characters), we can solve the second problem in polynomial time. We can also compute a fixed-topology 2-phylogeny (when one exists) for an arbitrary number of states. This algorithm can be used to further distinguish trees that are equal under parsimony. We also consider a number of other related problems. DOE

**SUBJECT TERMS →** *Algorithms; Biological Evolution; Chemical Evolution; Genetics; Molecular Biology*

# AERONAUTICAL ENGINEERING

*A Continuing Bibliography (Suppl. 330)*

MAY 1996

## 01 AERONAUTICS (GENERAL)

**N96-18604*** National Aeronautics and Space Administration, Washington, DC.

**Aeronautical engineering: A cumulative index to a continuing bibliography (supplement 325)**

Dec. 1995 459 p

Report No.(s): (NASA-SP-7037(325); NAS 1.21: 7037(325) Avail: CASI HC A20

This publication is a cumulative index to the abstracts contained in NASA SP-7037 supplements 313 through 324 of Aeronautical Engineering: A Continuing Bibliography. The bibliographic series is compiled through the cooperative efforts of the American Institute of Aeronautics and Astronautics (AIAA) and the National Aeronautics and Space Administration (NASA). This Cumulative index includes: a subject, personal author, corporate source, foreign technology, contract number, report number, and accession number.

Author

*Aerodynamics; Aeronautical Engineering; Aeronautics; Bibliographies; Indexes (documentation);*

## 02 AERODYNAMICS

*Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.*

**N96-18195#** National Renewable Energy Lab., Golden, CO.

**Dynamic stall occurrence on a horizontal axis wind turbine blade**

Shipley, D. E.; (Colorado Univ., Boulder, CO.)Miller, M. S.; (Colorado Univ., Boulder, CO.)and Robinson, M. C.; (Colorado Univ., Boulder, CO.)Jul. 1995 7 p Presented at the 1995 American Society of Mechanical Engineers (ASME) Energy Sources Technology Conference and Exhibition, Houston, TX, 29 Jan. - 1 Feb. 1995

Contract(s)/Grant(s): (DE-AC36-83CH-10093)

Report No.(s): (DE95-009264; NREL/TP-442-6912; CONF-950116-8) Avail: CASI HC A02/MF A01

Surface pressure data from the National Renewable Energy Laboratory's 'Combined Experiment' were analyzed to provide a statistical representation of dynamic stall occurrence on a downwind horizontal axis wind turbine (HAWT). Over twenty thousand blade rotational cycles were each characterized at four span locations by the maximum leading edge suction pressure and by the azimuth, velocity, and yaw at which it occurred. Peak suction values at least twice that seen in static wind tunnel tests were taken to be indicative of dynamic stall. The occurrence of dynamic stall at all but the inboard station (30% span) shows good quantitative agreement with the theoretical limits on inflow velocity and yaw that should yield dynamic stall. Two hypotheses were developed to explain the discrepancy at 30% span. Estimates are also given for the frequency of dynamic stall occurrence on upwind turbines. Operational regimes were identified which minimize the occurrence of dynamic stall events.

DOE

*Aerodynamic Stalling; Rotor Aerodynamics; Turbine Blades; Wind Turbines;*

**N96-18402*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**A mixed volume grid approach for the Euler and Navier-Stokes equations**

Coirier, William J.; and Jorgenson, Philip C. E.; 1 Jan. 1996 17 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA

Report No.(s): (NASA-TM-107135; NAS 1.15:107135; AIAA PAPER 96-0762; E-10065; NIPS-96-07909) Avail: CASI HC A03/MF A01

An approach for solving the compressible Euler and Navier-Stokes equations upon meshes composed of nearly arbitrary polyhedra is described. Each polyhedron is constructed from an arbitrary number of triangular and quadrilateral face elements, allowing the unified treatment of tetrahedral, prismatic, pyramidal, and hexahedral cells, as well the general cut cells produced by Cartesian mesh approaches. The basics behind the numerical approach and the resulting data structures are described. The accuracy of the mixed volume grid approach is assessed by performing a grid

refinement study upon a series of hexahedral, tetrahedral, prismatic, and Cartesian meshes for an analytic inviscid problem. A series of laminar validation cases are made, comparing the results upon differing grid topologies to each other, to theory, and experimental data. A computation upon a prismatic/tetrahedral mesh is made simulating the laminar flow over a wall/cylinder combination.
Author
*Cartesian Coordinates; Compressible Flow; Computational Fluid Dynamics; Computational Grids; Euler Equations of Motion; Grid Generation (mathematics); Inviscid Flow; Laminar Flow; Navier-stokes Equation;*

**N96-18422*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**Spreading characteristics and thrust of jets from asymmetric nozzles**
Zaman, K. B. m. Q.; 1 Dec. 1995 19 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA Original contains 4 color illustrations
Contract(s)/Grant(s): (RTOP 537-02-22)
Report No.(s): (NASA-TM-107132; NAS 1.15:107132; E-10062; AIAA PAPER 96-0200; NIPS-96-08131) Avail: CASI HC A03/MF A01

The spreading characteristics of jets from several asymmetric nozzles are studied in comparison to those of an axisymmetric jet, over the Mach number (M(sub J)) range of 0.3 to 1.96. The effect of tabs in two cases, the axisymmetric nozzle fitted with four tabs and a rectangular nozzle fitted with two large tabs, is also included in the comparison. Compared to the axisymmetric jet, the asymmetric jets spread only slightly faster at subsonic conditions, while at supersonic conditions, when screech occurs, they spread much faster. Screech profoundly increases the spreading of all jets. The effect varies in the different stages of screech, and the corresponding unsteady flowfield characteristics are documented via phase-averaged measurement of the fluctuating total pressure. An organization and intensification of the azimuthal vortical structures under the screeching condition is believed to be responsible for the increased spreading. Curiously, the jet from a 'lobed mixer' nozzle spreads much less at supersonic conditions compared to all other cases. This is due to the absence of screech with this nozzle. Jet spreading for the two tab configurations, on the other hand, is significantly more than any of the no-tab cases. This is true in the subsonic regime, as well as in the supersonic regime in spite of the fact that screech is essentially eliminated by the tabs. The dynamics of the streamwise vortex pairs produced by the tabs cause the most efficient jet spreading thus far observed in the study.
Author
*Asymmetry; Axisymmetric Flow; Nozzle Flow; Sound Pressure; Spreading; Tabs (control Surfaces); Vortices;*

**N96-18440*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**Implementation of a two-equation k-omega turbulence model in NPARC**
Yoder, Dennis A.; Georgiadis, Nicholas J.; and Orkwis, Paul D.; (Cincinnati Univ., OH.)1 Jan. 1996 22 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA
Contract(s)/Grant(s): (RTOP 537-02-23)
Report No.(s): (NASA-TM-107080; NAS 1.15:107080; E-9955; AIAA PAPER 96-0383; NIPS-96-08118) Avail: CASI HC A03/MF A01

The implementation of a two-equation k-omega turbulence model into the NPARC flow solver is described. Motivation for the selection of this model is given, major code modifications are outlined, new imputs to the code are described, and results are presented for several validation cases: an incompressible flow over a smooth flat plate, a subsonic diffuser flow, and a shock-induced separated flow. Comparison of results with the k-epsilon model indicate that the k-omega model predicts simple flows equally well whereas, for adverse pressure gradient flows, the k-omega model outperforms the other turbulence models in NPARC.
Author
*Applications Programs (computers); Boundary Layer Flow; Computational Fluid Dynamics; Incompressible Flow; Separated Flow; Subsonic Flow; Transition Flow; Turbulence Models; Turbulent Boundary Layer;*

**N96-18732*#** College of William and Mary, Williamsburg, VA. Dept. of Applied Science.
**Simulation of crossflow instability on a supersonic highly swept wing Final Report**
Pruett, C. David; 1 Oct. 1995 39 p
Contract(s)/Grant(s): (NAS1-19656; F49620-95-1-0146; RTOP 505-59-50-02)
Report No.(s): (NASA-CR-198267; NAS 1.26:198267; NIPS-96-08486) Avail: CASI HC A03/MF A01

A direct numerical simulation (DNS) algorithm has been developed and validated for use in the investigation of crossflow instability on supersonic swept wings, an application of potential relevance to the design of the High-Speed Civil Transport (HSCT). The algorithm is applied to the investigation of stationary crossflow instability on an infinitely long 77-degree swept wing in Mach 3.5 flow. The results of the DNS are compared with the predictions of linear parabolized stability equation (PSE) methodology. In-general, the DNS and PSE results agree closely in terms of modal growth rate, structure, and orientation angle. Although further validation is needed for large-amplitude (nonlinear) dis-

turbances, the close agreement between independently derived methods offers preliminary validation of both DNS and PSE approaches.
Author
*Boundary Layer Transition; Civil Aviation; Computational Fluid Dynamics; Cross Flow; Flow Stability; Incompressible Flow; Navier-stokes Equation; Runge-kutta Method; Supersonic Speed; Supersonic Transports; Three Dimensional Boundary Layer;*

**N96-19075*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**Control effectiveness and tip-fin dihedral effects for the HL-20 lifting-body configuration at Mach numbers from 1.6 to 4.5**
Cruz, Christopher I.; and Ware, George M.; 1 Dec. 1995 92p
Contract(s)/Grant(s): (RTOP 506-40-61-01)
Report No.(s): (NASA-TM-4697; NAS 1.15:4697; L-17183; NIPS-96-07905) Avail: CASI HC A05/MF A01

Wind tunnel tests were made with a scale model of the HL-20 in the Langley Unitary Plan Wind Tunnel. Pitch control was investigated by deflecting the elevon surfaces on the outboard fins and body flaps on the fuselage. Yaw control tests were made with the all movable center fin deflected 5 deg. Almost full negative body flap deflection (-30 deg) was required to trim the HL-20 (moment reference center at 0.54-percent body length from nose) to positive values of life in the Mach number range from 1. 6 to 2.5. Elevons were twice as effective as body flaps as a longitudinal trim device. The elevons were effective as a roll control, but because of tip-fin dihedral angle, produced about as much adverse yawing moment as rolling moment. The body flaps were less effective in producing rolling moment, but produced little adverse yawing moment. The yaw effectiveness of the all movable center fin was essentially constant over the angle-of-attack range at each Mach number. The value of yawing moment, however, was small. Center-fin deflection produced almost no rolling moments. The model was directionally unstable over most of the Mach number range with tip-fin dihedral angles less than the baseline value of 50 deg.
Author
*Controllability; Deflection; Dihedral Angle; Lifting Bodies; Mach Number Fins; Supersonic Speed; Wind Tunnel Tests;*

**N96-19095#** Cornell Univ., Ithaca, NY.
**Turbulence modeling: Second order closures for compressible turbulence in external aerodynamics Final Technical Report, 1 Oct. 1991 - 30 Sep. 1994**
Lumley, John L.; Caughey, D. A.; Savarese, S.; and Volte, C. C.; 1 Sep. 1995 11 p
Contract(s)/Grant(s): (F49620-92-J-0038; AF PROJ. 2307)
Report No.(s): (AD-A299357; AFOSR-95-0632TR) Avail: CASI HC A03/MF A01

Beginning with the code flo1O3 of Jameson and Martinelli, a robust, flexible numerical platform has been constructed which can accept 0 and R meshes as well as C, accepts a variable number of PDEs in the turbulence models, has consistent gradient compensation, enhanced multi-grid sequencing, a restart option, various post-processing options, the option of recording convergence histories, accepts k-e, k-e-S, second order and Baldwin-Lomax turbulence models, has dynamical memory allocation, vectorized data structure and Unix integration, and computes subsonic, transonic and supersonic flows. Virtually any turbulence model can be run in essentially any two-dimensional geometry, so that they. can be compared on an equal footing. The following cases have been computed: homogeneous grid turbulence; plane jet and mixing layer; flat plate boundary layers; semi-infinite plate (subsonic (Clauser) and supersonic (Delery)); finite plate (subsonic (ONERA)); supersonic compression ramp (Settles et al - Mach 2.93); Delery bump. Documentation is in preparation.
DTIC
*Aerodynamics; Closures; Data Structures; Gradients; Homogeneous Turbulence; Partial Differential Equations; Subsonic Flow; Supersonic Flow; Transonic Flow; Turbulence Models; Unix (operating System);*

**N96-19286*#** Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
**An experimental investigation of the flow physics of high-lift systems Annual Report, Mar.-Dec. 1995**
Thomas, Flint O.; and Nelson, R. C.; 20 Dec. 1995 31 p
Contract(s)/Grant(s): (NAG2-905)
Report No.(s): (NASA-CR-200211; NAS 1.26:200211; NIPS-96-08370) Avail: CASI HC A03/MF A01

This progress report, a series of viewgraphs, outlines experiments on the flow physics of confluent boundary layers for high lift systems. The design objective is to design high lift systems with improved C(sub Lmax) for landing approach and improved take-off L/D and simultaneously reduce acquisition and maintenance costs. In effect, achieve improved performance with simpler designs. The research objectives include: establish the role of confluent boundary layer flow physics in high-lift production; contrast confluent boundary layer structure for optimum and non-optimum C(sub L) cases; formation of a high quality, detailed archival data base for CFD/modeling; and examination of the role of relaminarization and streamline curvature.
Derived from text
*Aerodynamic Configurations; Airfoils; Boundary Layer Flow; Boundary Layer Transition; Design Analysis; Flow Visualization; Lift Drag Ratio;*

**N96-19294*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.
**A dynamic response model for pressure sensors in contin-**

**uum and high Knudsen number flows with large temperature gradients**

Whitmore, Stephen A.; Petersen, Brian J.; (California Univ., Los Angeles, CA.)and Scott, David D.; (Lawrence Livermore National Lab., Livermore, CA.)1 Jan. 1996 42 p Presented at the 34th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996

Report No.(s): (NASA-TM-4728; NAS 1.15:4728; AIAA PAPER 96-0563; H-2083; NIPS-96-08937) Avail: CASI HC A03/MF A01

This paper develops a dynamic model for pressure sensors in continuum and rarefied flows with longitudinal temperature gradients. The model was developed from the unsteady Navier-Stokes momentum, energy, and continuity equations and was linearized using small perturbations. The energy equation was decoupled from momentum and continuity assuming a polytropic flow process. Rarefied flow conditions were accounted for using a slip flow boundary condition at the tubing wall. The equations were radially averaged and solved assuming gas properties remain constant along a small tubing element. This fundamental solution was used as a building block for arbitrary geometries where fluid properties may also vary longitudinally in the tube. The problem was solved recursively starting at the transducer and working upstream in the tube. Dynamic frequency response tests were performed for continuum flow conditions in the presence of temperature gradients. These tests validated the recursive formulation of the model. Model steady-state behavior was analyzed using the final value theorem. Tests were performed for rarefied flow conditions and compared to the model steady-state response to evaluate the regime of applicability. Model comparisons were excellent for Knudsen numbers up to 0.6. Beyond this point, molecular affects caused model analyses to become inaccurate.

Author

*Continuum Flow; Dynamic Models; Hypersonics; Knudsen Flow; Navier-stokes Equation; Pressure Sensors; Rarefied Gas Dynamics;*

**N96-19414#** Stanford Univ., CA. Dept. of Mechanical Engineering.

**Research on supersonic reacting flows Annual Technical Report, 15 Feb. 1994 - 14 Feb. 1995**

Bowman, C. T.; Hanson, R. K.; Mungal, M. G.; and Reynolds, W. C.; 15 Mar. 1995 144 p Limited Reproducibility: Document partially illegible

Contract(s)/Grant(s): (F49620-94-1-0152; AF PROJ. 2308)

Report No.(s): (AD-A299395; AFOSR-95-0608TR) Avail: CASI HC A07/MF A02

An experimental and computational investigation of supersonic reacting flows, with the objective of gaining a fundamental understanding of the flow physics and chemistry interactions, is in progress. During the past year, experiments were conducted in a supersonic shear flow facility to visualize the instantaneous, three-dimensional structure of the compressible mixing layer and to measure the mixing efficiency. The mixing efficiency was measured by applying a new planar laser-induced fluorescence (PLIF) technique, termed 'cold chemistry.' The PLIF techniques were refined to allow measurements of temperature, velocity, and multiple species in transient high-speed flows. Current codes for direct numerical simulation of time-developing, three-dimensional, reacting, compressible mixing layers were adapted for a new generation of supercomputers. Previously-developed stability analyses were extended to the range of conditions being investigated in the supersonic reacting flow experiments.

DTIC

*Computational Fluid Dynamics; Mixing Layers (fluids); Reacting Flow; Supersonic Combustion; Supersonic Flow; Three Dimensional Flow; Turbulent Flow; Turbulent Mixing; Wind Tunnel Tests;*

**N96-19518*#** Tennessee Univ. Space Inst., Tullahoma, TN.

**Supersonic laminar flow control research Semiannual Report, Jul. - Dec. 1995**

Lo, Ching F.; and Wiberg, Clark G.; 1 Dec. 1995 20 p

Contract(s)/Grant(s): (NAG2-881)

Report No.(s): (NASA-CR-199975; NAS 1.26:199975; REPT-4; NIPS-96-07064) Avail: CASI HC A03/MF A01

The objective is to understand supersonic laminar flow stability, transition, and active control. Some prediction techniques will be developed or modified to analyze laminar flow stability. The effects of distributed heating and cooling as an active boundary layer control technique will be studied. The primary tasks of the research apply to the NASA/Ames Proof of Concept (PoC) and Laminar Flow Supersonic Wind Tunnel's (LFSWT's) nozzle design with laminar flow control and are listed as follows: (1) predictions of supersonic laminar boundary layer stability and transition, (2) effects of wall heating and cooling on supersonic laminar flow control, (3) performance evaluation of the PoC and LFSWT nozzle designs with wall heating and cooling applied at different locations and various lengths, and (4) effects of a conducted versus pulse wall temperature distribution for the LFSWT.

Derived from text

*Boundary Layer Control; Boundary Layer Stability; Boundary Layer Transition; Laminar Boundary Layer; Supersonic Boundary Layers; Supersonic Wind Tunnels; Wind Tunnel Nozzles;*

**N96-19519*#** Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.

**An experimental investigation of the flow physics of high-lift systems Annual Report, Mar. - Dec. 1995**

Thomas, Flint O.; and Nelson, R. C.; 20 Dec. 1995 33 p

Contract(s)/Grant(s): (NAG2-905)

Report No.(s): (NASA-CR-199974; NAS 1.26:199974; NIPS-96-07065) Avail: CASI HC A03/MF A01

This progress report is a series of overviews outlining experiments on the flow physics of confluent boundary layers for high-lift systems. The research objectives include establishing the role of confluent boundary layer flow physics in high-lift production; contrasting confluent boundary layer structures for optimum and non-optimum C(sub L) cases; forming a high quality, detailed archival data base for CFD/modelling; and examining the role of relaminarization and streamline curvature. Goals of this research include completing LDV study of an optimum C(sub L) case; performing detailed LDV confluent boundary layer surveys for multiple non-optimum C(sub L) cases; obtaining skin friction distributions for both optimum and non-optimum C(sub L) cases for scaling purposes; data analysis and inner and outer variable scaling; setting-up and performing relaminarization experiments; and a final report establishing the role of leading edge confluent boundary layer flow physics on high-lift performance.

CASI

*Aircraft Design; Airfoil Profiles; Boundary Layer Flow; Computational Fluid Dynamics; Flow Visualization; Laminar Flow; Lift;*

## 03 AIR TRANSPORTATION AND SAFETY

*Includes passenger and cargo air transport operations; and aircraft accidents.*

**N96-17765#** Wichita State Univ., Wichita, KS. Aviation Inst.

**The Airline Quality Report 1995**

Bowen, Brent D.; and Headley, Dean E.; 1 Apr. 1995 41 p

Report No.(s): (NIAR-95-11; NIPS-96-07032) Avail: CASI HC A03/MF A01

The Airline Quality Rating (AQR) was developed and first announced in early 1991 as an objective method of comparing airline performance on combined multiple factors important to consumers. Development history and calculation details for the AQR rating system are detailed in The Airline Quality Rating (NIAR Report 91-11) issued in April, 1991, by the National Institute for Aviation Research at Wichita State University. This current report, Airline Quality Rating 1995 (NIAR Report 95-11), contains monthly Airline Quality Rating scores for 1994. Additional copies are available by contacting Wichita State University or University of Nebraska at Omaha. The Airline Quality Rating 1995 (NIAR Report 95-11) is a summary of month-by-month quality ratings for the nine major domestic U.S. airlines operating during 1994. Using the Airline Quality Rating system and monthly performance data for each airline for the calendar year of 1994, individual and comparative ratings are reported. This research monograph, NIAR Report 95-11, contains a brief summary of the AQR methodology, detailed data and charts that track comparative quality for major domestic airlines across the 12 month period of 1994, and industry average results. Also, comparative Airline Quality Rating data for 1991 through 1994 is included to provide a longer term view of quality in the industry.

Author

*Airline Operations; Civil Aviation; Commercial Aircraft; Ratings;*

**N96-17825#** Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.

**An economical alternative for the secondary container used for transporting infectious disease substances Final Report**

Mandella, Jr., Joseph G.; and Garner, Robert P.; 1 Dec. 1995 8 p

Report No.(s): (DOT/FAA/AM-95/29; AM-B-94-PHY-152; NIPS-96-07029) Avail: CASI HC A02/MF A01

The safe containment of biological specimens during air transport is of growing concern as the number of shipments and hazards associated with such material increases. The purpose of this study was to examine the durability of adhesive-closure polyethylene (PE) bags upon exposure to altitude. The tests consisted of two phases. The objective of the first phase was to identify the most appropriate combination of bag composition, thickness, and size. The second phase was to determine the most appropriate packing techniques to be used with the bag best suited for air transport. Both phases consisted of a hypobaric chamber being taken to a simulated altitude of 45, 000 feet. The PE bags contained specimens packaged in International Air Transportation Association approved containers. Initial tests indicated that differences in material composition and thickness did not significantly alter the ability of the PE bags to withstand the pressure differential. The second test phase suggested that the most effective means of preventing bag rupture upon exposure to altitude was to use oversized bags, evacuated of any residual air as completely as possible.

Author

*Air Transportation; Altitude Simulation; Anthropometry; Bags; Performance Tests; Polyethylenes; Specimens;*

**N96-17875#** Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.

**Drugs and alcohol found in fatal civil aviation accidents between 1989 and 1993 Final Report**

Canfield, Dennis; Flemig, JO; Hordinsky, Jerry; and Birky, Merritt; (National Transportation Safety Board, Washington, DC.)1 Nov. 1995 9 p

Report No.(s): (DOT/FAA/AM-95/28; AM-B-94-TOX-66; NIPS-96-07039) Avail: CASI HC A02/MF A01

The FAA Office of Aviation Medicine's Civil Aeromedical Institute (CAMI) is tasked under public law

100-59(H.R. 4686): November 3, 1988, AVIATION SAFETY RESEARCH ACT OF 1988 to conduct toxicology tests on aviation accidents and determine the effects of drugs and alcohol are being used by pilots involved in aviation accidents so that the FAA can take steps to prevent pilots from using drugs or alcohol, which could impair their ability to fly an aircraft. The toxicology reports prepared by the CAMI Forensic Toxicology Research Section are used by the FAA and the National Transportation Safety Board to determine the cause of aviation accidents and evaluate present FAA regulations. Specimens (blood, urine, liver, kidney, vitreous, and other bodily specimens) were collected by pathologists near the accident and placed in evidence containers provided by CAMI. These samples were refrigerated and shipped by overnight air. Upon receipt, the specimens were inventoried and accessioned for the analysis of drugs, alcohol, carbon monoxide, and cyanide. All data collected by the laboratory were electronically entered into a computer for future analysis. The data base was searched using a program developed by the Forensic Toxicology Research Section. The data base was sorted based on the class of drug, controlled dangerous substance schedules 1 and 2, controlled dangerous substance schedules 3-5, prescription drugs, over-the-counter-drugs, and alcohol. The Toxicology and Accident Research Laboratory received specimens from 1845 pilots for postmortem toxicology analysis between 1989 and 1993. Controlled dangerous substances, CDCs (schedules 1 and 2), were found in 74 of the pilots analyzed. Controlled dangerous substances (schedules 3-5) were found in 28 of the pilots tested. Prescription drugs were found in 110 of the pilots analyzed. Over-the-counter drugs were found in 207 of the pilots analyzed. Alcohol at or above the legal limit of 0.04% was found in 146 of the pilots analyzed. The reported number of positive drug cases has doubled over the past 5 years. Over-the-counter medications are the most frequently found drugs in fatal aviation accidents and many of these drugs, or the medical conditions for which they are being used, could impair a pilot's ability to safely fly an aircraft. The increased number of positive cases found in this research is most likely the result of improved methods of analysis, rather than an increase in the use of drugs. The low incidence of CDC 3-5 drugs found in fatal aviation accidents may be a result of the difficulty in finding and identifying the new benzodiazepines commonly prescribed in this class.

Author

*Aerospace Medicine; Aircraft Accidents; Aircraft Safety; Civil Aviation; Flight Safety; Methamphetamine; Narcotics; Pilots (personnel); Safety Management; Sedatives Alcohols; Toxicology;*

**N96-18414*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**Further evaluation of traditional icing scaling methods**

Anderson, David N.; 1 Jan. 1996 20 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA

Contract(s)/Grant(s): (RTOP 505-68-10)

Report No.(s): (NASA-TM-107140; NAS 1.15:107140; E-10070; AIAA PAPER 96-0633; NIPS-96-08125) Avail: CASI HC A03/MF A01

This report provides additional evaluations of two methods to scale icing test conditions; it also describes a hybrid technique for use when scaled conditions are outside the operating envelope of the test facility. The first evaluation is of the Olsen method which can be used to scale the liquid-water content in icing tests, and the second is the AEDC (Ruff) method which is used when the test model is less than full size. Equations for both scaling methods are presented in the paper, and the methods were evaluated by performing icing tests in the NASA Lewis Icing Research Tunnel (IRT). The Olsen method was tested using 53 cm diameter NACA 0012 airfoils. Tests covered liquid-water-contents which varied by as much as a factor of 1.8. The Olsen method was generally effective in giving scale ice shapes which matched the reference shapes for these tests. The AEDC method was tested with NACA 0012 airfoils with chords from 18 cm to 53 cm. The 53 cm chord airfoils were used in reference tests, and 1/2 and 1/3 scale tests were made at conditions determined by applying the AEDC scaling method. The scale and reference airspeeds were matched in these tests. The AEDC method was found to provide fairly effective scaling for 1/2 size tests, but for 1/3 size models, scaling was generally less effective. In addition to these two scaling methods, a hybrid approach was also tested in which the Olsen method was used to adjust the LWC after size was scaled using the constant Weber number method. This approach was found to be an effective way to test when scaled conditions would otherwise be outside the capability of the test facility.

Author

*Airfoils; Ice Formation; Moisture Content; Scaling Laws; Wind Tunnel Tests;*

**N96-18415*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**Evaluation of constant-Weber-number scaling for icing tests**

Anderson, David N.; 1 Jan. 1996 17 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA

Contract(s)/Grant(s): (RTOP 505-68-10)

Report No.(s): (NASA-TM-107141; NAS 1.15:107141; E-10071; AIAA PAPER 96-0636; NIPS-96-08126) Avail: CASI HC A03/MF A01

Previous studies showed that for conditions simulating an aircraft encountering super-cooled water droplets the droplets may splash before freezing. Other surface effects dependent on the water surface tension may also influence the ice accretion process. Consequently, the Weber number

appears to be important in accurately scaling ice accretion. A scaling method which uses a constant-Weber-number approach has been described previously; this study provides an evaluation of this scaling method. Tests are reported on cylinders of 2.5 to 15-cm diameter and NACA 0012 airfoils with chords of 18 to 53 cm in the NASA Lewis Icing Research Tunnel (IRT). The larger models were used to establish reference ice shapes, the scaling method was applied to determine appropriate scaled test conditions using the smaller models, and the ice shapes were compared. Icing conditions included warm glaze, horn glaze and mixed. The smallest size scaling attempted was 1/3, and scale and reference ice shapes for both cylinders and airfoils indicated that the constant-Weber-number scaling method was effective for the conditions tested.
Author
*Airfoils; Ice; Ice Formation;*

**N96-18437*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**Overview of the preparation and use of an OV-10 aircraft for wake vortex hazards flight experiments**
Stuever, Robert A.; Stewart, Eric C.; and Rivers, Robert A.; 1 Jan. 1995 23 p Presented at the 1st AIAA Aircraft Engineering, Technology, and Operations Congress , Los Angeles, CA, United States, 19-21 Sep. 1995
Report No.(s): (NASA-TM-111259; NAS 1.15:111259; AIAA PAPER 95-3935; NIPS-96-07977) Avail: CASI HC A03/MF A01

An overview is presented of the development, use, and current flight-test status of a highly instrumented North American Rockwell OV-10A Bronco as a wake-vortex-hazards research aircraft. A description of the operational requirements and measurements criteria, the resulting instrumentation systems and aircraft modifications, system-calibration and research flights completed to date, and current flight status are included. These experiments are being conducted by the National Aeronautics and Space Administration as part of an effort to provide the technology to safely improve the capacity of the nation's air transportation system and specifically to provide key data in understanding and predicting wake vortex decay, transport characteristics, and the dynamics of encountering wake turbulence. The OV-10A performs several roles including meteorological measurements platform, wake-decay quantifier, and trajectory-quantifier for wake encounters. Extensive research instrumentation systems include multiple airdata sensors, video cameras with cockpit displays, aircraft state and control-position measurements, inertial aircraft-position measurements, meteorological measurements, and an onboard personal computer for real-time processing and cockpit display of research data. To date, several of the preliminary system check flights and two meteorological-measurements deployments have been completed. Several wake encounter and wake-decay-measurements flights are planned for the fall of 1995.
Author
*Flow Characteristics; Hazards; Meteorological Parameters; Turbulence; Vortices; Wakes;*

**N96-18603#** Wright Lab., Tyndall AFB, FL. Airbase Fire Protection and Crash Rescue Systems.
**MARK 2A Aqueous Film Forming Foam (AFFF) precision metering system product evaluation test report Final Report, 16 Dec. 1992 - 9 Nov. 1994**
Rettie, Bob; Grimm, Wade H.; Kelley, Stephen E.; and Dees, Billy R.; Aug. 1995 61 p
Report No.(s): (AD-A299364; ASC-TR-95-1004) Avail: CASI HC A04/MF A01

Final report of the commercial technology exploitation evaluation of a computer controlled AFFF metering system produced by NORDIC Systems Inc. of Toronto, Canada is presented. The initial evaluation was conducted by Wright Laboratory, Airbase Fire Protection and Crash Rescue Systems section at Tyndall AFB, Florida on 16 Dec. 1992 - 25 Jun. 1993. This initial evaluation used paddle wheels to determine liquid flow rates, but resulted in irregular concentrations of foam. A follow-on evaluation incorporating magnetic flow meters was conducted on 7-9 Nov. 1994. The test evaluated foam concentrations of 1, 3 and 6 percent. The system met user requirements and has been recommended for retrofit onto Air Force P-19, P-23 and other front-line ARFF vehicles.
DTIC
*Accident Prevention; Aircraft Accidents; Aircraft Safety; Fire Extinguishers; Fire Fighting; Fire Prevention; Flow Velocity; Fluid Films; Foams; Performance Tests;*

**N96-18817#** Federal Aviation Administration, Atlantic City, NJ. Airport Security Human Factors Program.
**Test and evaluation plan for the Explosive Device Detection Baseline (EDDB) study Final Draft Report**
Fobes, J. L.; McAnulty, D. Michael; Klock, Brenda A.; Janowitz, J.; (Galaxy Scientific Corp., Mays Landing, NJ.)Neiderman, E.; (Galaxy Scientific Corp., Mays Landing, NJ.)and Malone, R. L.; (Galaxy Scientific Corp., Mays Landing, NJ.)Aug. 1995 32 p
Contract(s)/Grant(s): (DTFA03-89-C-00043)
Report No.(s): (AD-A298890; DOT/FAA/AR-95/16) Avail: CASI HC A03/MF A01

This document is the Test and Evaluation Plan (TEP) to evaluate Improvised Explosive Device (IED) detection capabilities. Specifically, the testing effort will evaluate the ability of airport security personnel to detect lED's in carry-on passenger bags. The test and evaluation (T&E) focuses on determining the baseline performance levels as set forth in the Critical Operational Issues and Criteria (COIC). The T&E will be conducted at 19 U.S. Category X (CAT X) air-

ports. The results will be analyzed and become part of a later document.
DTIC
*Airport Security; Airports; Civil Aviation; Explosive Devices;*

## 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

*Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.*

**N96-18298#** Universidade Estadual de Campinas (Brazil).
**Neurofuzzy navigation control and neural group selection c04**
Oliveira, Marco; Figueiredo, Mauricio; Gomide, Fernando; and Romero, Luis; In INPE, IFSA 1995: Proceedings of the 6th International Fuzzy Systems Association World Congress, Volume 1 28 Jul. 1995 p 73-76 Prepared in cooperation with Valladolid Univ. (Spain) (For primary document see N96-18292 05-67) Avail: CASI HC A01/MF A06

The problem of autonomous robot navigation control is considered in this paper. The intrinsic difficulties of the autonomous navigation problem have captivated many artificial intelligence researchers, who have found it to be of a considerable challenge. Many different methods have been reported in the literature. Here we propose an artificial neural network approach based on the theory of neural group selection as an alternative autonomous navigation controller. The repertories are structured fuzzy neural networks whose parameters are obtained by a genetic algorithm. The simulation results show characteristics of the method and point out questions which deserve further research.
Author
*Artificial Intelligence; Autonomous Navigation; Machine Learning; Neural Nets; Robot Control; Robot Dynamics;*

**N96-18300#** Israel Aircraft Industries Ltd., Ben-Gurion Airport (Israel).
**On the role of applied fuzzy logic in automated landing of unmanned aircraft c04**
Livchitz, Michael; Abershitz, Abraham; Soudak, Uri; and Kandel, Abraham; (University of South Florida, Tampa, FL.)In INPE, IFSA 1995: Proceedings of the 6th International Fuzzy Systems Association World Congress, Volume 1 28 Jul. 1995 p 129-131 (For primary document see N96-18292 05-67) Avail: CASI HC A01/MF A06

Fuzzy control is a promising novel branch of control theory which can and should open up new vistas of applications. In this paper the application of fuzzy logic to the design of an automated landing system for an unmanned aircraft is discussed.
Author
*Control Theory; Controllers; Fuzzy Systems; Knowledge Based Systems; Landing Aids; Pilotless Aircraft;*

**N96-18303#** Centre National de la Recherche Scientifique, Toulouse (France).
**Improved automatic landing by fuzzy sliding mode control c04**
Mora-Camino, F.; Achaibou, A. K.; Asep, R.; and Shen, T. J.; In INPE, IFSA 1995: Proceedings of the 6th International Fuzzy Systems Association World Congress, Volume 1 28 Jul. 1995 p 413-416 (For primary document see N96-18292 05-67) Avail: CASI HC A01/MF A06

We consider the problem of the control of the flight path of a landing aircraft. This nonlinear control problem is analyzed from a practical point of view, the limitations of its present solution are discussed as well as the usefulness of introduction of fuzzy concepts.
Author
*Control Systems Design; Control Theory; Flight Paths; Fuzzy Systems; Landing;*

**N96-18311#** National Cheng Kung Univ., Tainan (Taiwan). Inst. of Aeronautics and Astronautics.
**An experiment of fuzzy logic tuning on extended Kalman filter applied to ground GPS navigation c04**
Ho, Ching-Shun; In INPE, IFSA 1995: Proceedings of the 6th International Fuzzy Systems Association World Congress, Volume 1 28 Jul. 1995 p 605-608 (For primary document see N96-18292 05-67) Avail: CASI HC A01/MF A06

The extended form of Kalman filter has been proved to be a reliable tool in target tracking problems. But it may experience divergence when unmodeled acceleration becomes large. The situation can be stabilized by augmenting the filter with process noise matrix. To select an appropriate process noise level is an important task. The studied approach is to dynamically tune the process noise level using a fuzzy logic input from measurement residues. Both simulated and GPS real data have been processed to verify the approach. The results show that the fuzzy tuning approach performs well and is capable of providing stable tracking solutions.
CASI
*Fuzzy Systems; Global Positioning System; Kalman Filters; Navigation Aids; Noise Reduction; Satellite Tracking; Tracking Problem; Tuning;*

**N96-18517*#** Israel Inst. of Tech., Haifa (Israel). Faculty of Aerospace Engineering.
**Advanced interactive display formats for terminal area traffic control Final Report, 1 Oct. 1994 - 30 Sept. 1995**
Grunwald, Arthur J.; 8 Jan. 1996 58 p
Contract(s)/Grant(s): (NCCW-45)
Report No.(s): (NASA-CR-200113; NAS 1.26:200113; NIPS-96-07728) Avail: CASI HC A04/MF A01

This report describes the basic design considerations for perspective air traffic control displays. A software framework has been developed for manual viewing parameter setting (MVPS) in preparation for continued, ongoing developments on automated viewing parameter setting (AVPS) schemes. Two distinct modes of MVPS operations are considered, both of which utilize manipulation pointers imbedded in the three-dimensional scene: (1) direct manipulation of the viewing parameters -- in this mode the manipulation pointers act like the control-input device, through which the viewing parameter changes are made. Part of the parameters are rate controlled, and part of them position controlled. This mode is intended for making fast, iterative small changes in the parameters. (2) Indirect manipulation of the viewing parameters -- this mode is intended primarily for introducing large, predetermined changes in the parameters. Requests for changes in viewing parameter setting are entered manually by the operator by moving viewing parameter manipulation pointers on the screen. The motion of these pointers, which are an integral part of the 3-D scene, is limited to the boundaries of the screen. This arrangement has been chosen in order to preserve the correspondence between the spatial lay-outs of the new and the old viewing parameter setting, a feature which contributes to preventing spatial disorientation of the operator. For all viewing operations, e.g. rotation, translation and ranging, the actual change is executed automatically by the system, through gradual transitions with an exponentially damped, sinusoidal velocity profile, in this work referred to as 'slewing' motions. The slewing functions, which eliminate discontinuities in the viewing parameter changes, are designed primarily for enhancing the operator's impression that he, or she, is dealing with an actually existing physical system, rather than an abstract computer-generated scene. The proposed, continued research efforts will deal with the development of automated viewing parameter setting schemes. These schemes employ an optimization strategy, aimed at identifying the best possible vantage point, from which the air traffic control scene can be viewed for a given traffic situation. They determine whether a change in viewing parameter setting is required and determine the dynamic path along which the change to the new viewing parameter setting should take place.
Author (revised)
*Air Traffic Control; Approach Control; Display Devices; Human-computer Interface;*

**N96-18532*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**Design principles and algorithms for automated air traffic management c04**
Erzberger, Heinz; In AGARD, Knowledge-Based Functions in Aerospace Systems 1 Nov. 1995 31 p (For primary document see N96-18527 05-63) Avail: CASI HC A03/MF A02

This paper presents design principles and algorithm for building a real time scheduler. The primary objective of the scheduler is to assign arrival aircraft to a favorable landing runway and schedule them to land at times that minimize delays. A further objective of the scheduler is to allocate delays between high altitude airspace far from the airport and low altitude airspace near the airport. A method of delay allocation is described that minimizes the average operating cost in the presence of errors in controlling aircraft to a specified landing time.
Author
*Air Traffic Control; Aircraft Approach Spacing; Algorithms; Automatic Control; Design Analysis; Flight Paths; Flight Plans; Real Time Operation; Scheduling;*

**N96-18533#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. of Flight Guidance.
**Structures, architectures and design principles for dynamic planning functions in ATM c04**
Voelckers, Uwe; and Boehme, D.; In AGARD, Knowledge-Based Functions in Aerospace Systems 1 Nov. 1995 18 p (For primary document see N96-18527 05-63) Avail: CASI HC A03/MF A02

Air Traffic Management (ATM) is a very complex and challenging domain. To cope with future traffic demand, while still maintaining or even increasing safety and efficiency of air traffic operations, intelligent machine functions have to be developed to assist the human operators in their mental control tasks. The specific requirements of the ATM domain necessitate sophisticated and well-designed assistance tools. Their most significant characteristics, design principles and structures are discussed and examplified in a real-world application.
Author
*Air Traffic Control; Flight Safety; Human-computer Interface; Planning; Scheduling; Systems Analysis;*

**N96-18722*#** Ohio State Univ., Columbus, OH. Cognitive Systems Engineering Lab.
**An empirical evaluation of graphical interfaces to support flight planning**
Smith, Philip J.; McCoy, Elaine; (Nebraska Univ., Omaha, NE.)Layton, Chuck; (Galaxy Scientific Corp., Atlanta, GA.)and Bihari, Tom; (Adaptive Machine Technologies, Inc., Columbia, OH.)1 Jan. 1995 112 p
Contract(s)/Grant(s): (NCC2-615)
Report No.(s): (NASA-CR-200218; NAS 1.26:200218; NIPS-96-08361) Avail: CASI HC A06/MF A02

Whether optimization techniques or expert systems technologies are used, the underlying inference processes and the model or knowledge base for a computerized problem-solving system are likely to be incomplete for any given complex, real-world task. To deal with the resultant brittleness, it has been suggested that 'cooperative' rather than 'au-

tomated' problem-solving systems be designed. Such cooperative systems are proposed to explicitly enhance the collaboration of people and the computer system when working in partnership to solve problems. This study evaluates the impact of alternative design concepts on the performance of airline pilots interacting with such a cooperative system designed to support enroute flight planning. Thirty pilots were studied using three different versions of the system. The results clearly demonstrate that different system design concepts can strongly influence the cognitive processes of users. Indeed, one of the designs studied caused four times as many pilots to accept a poor flight amendment. Based on think-aloud protocols, cognitive models are proposed to account for how features of the computer system interacted with specific types of scenarios to influence exploration and decision-making by the pilots. The results are then used to develop recommendations for guiding the design of cooperative systems.
Author
*Decision Making; Flight Plans; Graphical User Interface; Human-computer Interface; Pilot Performance; Planning;*

**N96-19043*#** Ohio State Univ., Columbus, OH. Cognitive Systems Engineering Lab.
**Enroute flight planning: Evaluating design concepts for the development of cooperative problem-solving systems Final Report**
Smith, Philip J.; 1 Jan. 1995 34 p
Contract(s)/Grant(s): (NCC2-615; NCA2-701)
Report No.(s): (NASA-CR-200216; NAS 1.26:200216; NIPS-96-08363) Avail: CASI HC A03/MF A01

There are many problem-solving tasks that are too complex to fully automate given the current state of technology. Nevertheless, significant improvements in overall system performance could result from the introduction of well-designed computer aids. We have been studying the development of cognitive tools for one such problem-solving task, enroute flight path planning for commercial airlines. Our goal has been two-fold. First, we have been developing specific system designs to help with this important practical problem. Second, we have been using this context to explore general design concepts to guide in the development of cooperative problem-solving systems. These design concepts are described below, along with illustrations of their application.
Author
*Civil Aviation; Commercial Aircraft; Complex Systems; Computer Techniques; Expert Systems; Flight Paths; Flight Plans; Problem Solving;*

## 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

*Includes aircraft simulation technology.*

**N96-18427*#** Lockheed Martin Engineering and Sciences Co., Hampton, VA.
**F-18 High Alpha Research Vehicle (HARV) parameter identification flight test maneuvers for optimal input design validation and lateral control effectiveness**
Morelli, Eugene A.; 1 Dec. 1995 49 p
Contract(s)/Grant(s): (NAS1-19000; RTOP 505-64-52-01)
Report No.(s): (NASA-CR-198248; NAS 1.26:198248; NIPS-96-08141) Avail: CASI HC A03/MF A01

Flight test maneuvers are specified for the F-18 High Alpha Research Vehicle (HARV). The maneuvers were designed for open loop parameter identification purposes, specifically for optimal input design validation at 5 degrees angle of attack, identification of individual strake effectiveness at 40 and 50 degrees angle of attack, and study of lateral dynamics and lateral control effectiveness at 40 and 50 degrees angle of attack. Each maneuver is to be realized by applying square wave inputs to specific control effectors using the On-Board Excitation System (OBES). Maneuver descriptions and complete specifications of the time/amplitude points define each input are included, along with plots of the input time histories.
Author
*Aerodynamics; Aircraft Control; Aircraft Maneuvers; Angle of Attack; Dynamic Control; F-18 Aircraft; Flight Tests; Lateral Control; Research; Research Aircraft;*

**N96-18504*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**Automatic differentiation evaluated as a tool for rotorcraft design and optimization**
Walsh, Joanne L.; and Young, Katherine C.; 2 Nov. 1995 14 p Presented at the American Helicopter Society National Technical Specialist' Meeting on Rotorcraft Structures: Design Challenges and Innovative Solutions, Williamsburg, VA, United States, 30 Oct. - 2 Nov. 1995
Report No.(s): (NASA-TM-111273; NAS 1.15:111273; NIPS-96-08085) Avail: CASI HC A03/MF A01

This paper investigates the use of automatic differentiation (AD) as a means for generating sensitivity analyses in rotorcraft design and optimization. This technique transforms an existing computer program into a new program that performs sensitivity analysis in addition to the original analysis. The original FORTRAN program calculates a set of dependent (output) variables from a set of independent (input) variables, the new FORTRAN program calculates the partial derivatives of the dependent variables with respect to the independent variables. The AD technique is a systematic implementation of the chain rule of differentiation, this method

produces derivatives to machine accuracy at a cost that is comparable with that of finite-differencing methods. For this study, an analysis code that consists of the Langley-developed hover analysis HOVT, the comprehensive rotor analysis CAMRAD/JA, and associated preprocessors is processed through the AD preprocessor ADIFOR 2.0. The resulting derivatives are compared with derivatives obtained from finite-differencing techniques. The derivatives obtained with ADIFOR 2.0 are exact within machine accuracy and do not depend on the selection of step-size, as are the derivatives obtained with finite-differencing techniques.
Author
*Applications Programs (computers); Computer Programs; Costs; Design Analysis; Rotary Wing Aircraft; Sensitivity;*

**N96-18505*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**Application of response surface techniques to helicopter rotor blade optimization procedure**
Henderson, Joseph Lynn; (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA.)Walsh, Joanne L.; and Young, Katherine C.; 2 Nov. 1995 18 p Presented at the American Helicopter Society Technical Specialist' Meeting on Rotorcraft Structures: Design Challenges and Innovative Solutions, Williamsburg, VA, United States, 30 Oct. - 2 Nov. 1995
Report No.(s): (NASA-TM-111274; NAS 1.15:111274; NIPS-96-08086) Avail: CASI HC A03/MF A01

In multidisciplinary optimization problems, response surface techniques can be used to replace the complex analyses that define the objective function and/or constraints with simple functions, typically polynomials. In this work a response surface is applied to the design optimization of a helicopter rotor blade. In previous work, this problem has been formulated with a multilevel approach. Here, the response surface takes advantage of this decomposition and is used to replace the lower level, a structural optimization of the blade. Problems that were encountered and important considerations in applying the response surface are discussed. Preliminary results are also presented that illustrate the benefits of using the response surface.
Author
*Design Analysis; Rotary Wings;*

**N96-18765#** Air Force Systems Command, Wright-Patterson AFB, OH. National Air Intelligence Center.
**Preliminary study on effects of thrust vectoring**
Baokai, Zhao; 1 Aug. 1995 17 p Transl. into ENGLISH from Feixing Lixue (China), v. 12, no. 1, Mar. 1994 p 23-27
Report No.(s): (AD-A299898; NAIC-ID(RS)T-0212-95) Avail: CASI HC A03/MF A01

With respect to the thrust vectoring technique adopted in aircraft, the paper is a preliminary study on the pneumatic properties, aircraft performance, and maneuverability after applying a two dimensional nozzle. Some conclusions are obtained.
DTIC
*Aircraft Performance; Automatic Flight Control; Flight Control; Maneuverability; Nozzle Geometry; Thrust Vector Control;*

**N96-18908#** Federal Aviation Administration, Atlantic City, NJ. Technical Center.
**The use of automotive glycol antifreeze test strips for determining the freeze point glycol-based aircraft deicing fluid Technical Note**
Pugacz, Edward J.; and Masters, Charles O.; Apr. 1995 19 p
Report No.(s): (AD-A299128; DOT/FAA/CT-TN95/24) Avail: CASI HC A03/MF A01

This Technical Note documents a series of tests performed to determine the accuracy of automotive glycol antifreeze test strips when used measure to the freeze point of glycol-based deicing and anti-icing fluids. Also employed in the tests was a refractometer, the currently accepted method used to determine de/anti-icing fluid freeze points. Varying concentrations of water and de/anti-icing fluid were used to provide a variety of test freeze points. The results of the two freeze point measurement methods are compared and discussed, and a recommendation made.
DTIC
*Antifreezes; Deicers; Deicing; Freezing; Glycols;*

**N96-19055*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**Reduction of Blade-Vortex Interaction (BVI) noise through X-force control**
Schmitz, Fredric H.; 1 Sep. 1995 29 p
Contract(s)/Grant(s): (RTOP 505-59-36)
Report No.(s): (NASA-TM-110371; NAS 1.15:110371; A-950104; NIPS-96-08786) Avail: CASI HC A03/MF A01

Momentum theory and the longitudinal force balance equations of a single rotor helicopter are used to develop simple expressions to describe tip-path-plane tilt and uniform inflow to the rotor. The uniform inflow is adjusted to represent the inflow at certain azimuthal locations where strong Blade-Vortex Interaction (BVI) is likely to occur. This theoretical model is then used to describe the flight conditions where BVI is likely to occur and to explore those flight variables that can be used to minimize BVI noise radiation. A new X-force control is introduced to help minimize BVI noise. Several methods of generating the X-force are presented that can be used to alter the inflow to the rotor and thus increasing the likelihood of avoiding BVI during approaches to a landing.
Author
*Aeroacoustics; Aircraft Landing; Blade Slap Noise; Blade-vortex Interaction; Flight Control; Flight Paths; Helicop-*

*ters; Inlet Flow; Longitudinal Stability; Noise Prediction (aircraft); Noise Reduction;*

**N96-19505*#** Lockheed Martin Engineering and Sciences Co., Hampton, VA.

**The F-18 High Alpha Research Vehicle (HARV) parameter identification flight test maneuvers for optimal input design validation and lateral control**

Morelli, Eugene A.; 1 Dec. 1995 49 p

Contract(s)/Grant(s): (NAS1-19000; RTOP 505-64-52-01)

Report No.(s): (NASA-CR-198248; NAS 1.26:198248; NIPS-96-06873) Avail: CASI HC A03/MF A01

Flight tests maneuvers are specified for the F-18 Alpha Research Vehicle (HARV). The maneuvers were designed for open loop parameter identification purposes, specifically for optimal input design validation at 5 degrees angle of attack, identification of individual strake effectiveness at 40 and 50 degrees angle of attack, and study of lateral dynamics and lateral control effectiveness at 40 and 50 degrees angle of attack. Each maneuver is to be realized by applying square wave inputs to specific control effectors using the On-Board Excitation System (OBES). Maneuver descriptions and complete specifications of the time/amplitude points defining each input are included, along with plots of the input time histories.

Author

*Aircraft Control; Angle of Attack; Control Equipment; Dynamic Control; F-18 Aircraft; Feedback Control; Flight Tests; Lateral Control; Parameter Identification; Research Vehicles;*

## 06 AIRCRAFT INSTRUMENTATION

*Includes cockpit and cabin display devices; and flight instruments.*

**N96-18883#** Army Aeromedical Research Lab., Fort Rucker, AL.

**A novel aircraft instrument display to minimize the risks of spatial disorientation Final Report**

Durnford, Simon J.; and Deroche, Shannon L.; Jun. 1995 42p

Contract(s)/Grant(s): (DA PROJ. 3M1-62787-A-879)

Report No.(s): (AD-A299102; USAARL-95-24) Avail: CASI HC A03/MF A01

A novel instrument display designed to reduce cognitive workload was tested against a standard instrument panel using a helicopter mockup linked to a computer flight simulator. Both pilots and nonpilots were used as subjects and tests involved recovery from unusual aircraft attitudes as well as flight maneuvering instruments. The novel display incorporates heading, speed, roll, and pitch into a single tracking task. Users set the desired heading and the desired speed (and the desired altitude and glide path). The display then guides control movements to achieve and maintain the desired parameters. Results from the unusual attitudes experiment showed significant benefits from the novel display, evident in improved performance on a secondary task (noise identification) and reduced control input errors. Results from the flying portion of the study showed significantly improved performance at the secondary task together with improved speed control when using the new display, although heading control was reduced. Further modifications to the new display have been introduced since these initial experiments, and further testing should be carried out using dynamic displays during unusual attitudes and continual data collection during flight.

DTIC

*Aircraft Instruments; Disorientation; Display Devices; Flight Instruments; Flight Simulators; Human Factors Engineering; Spatial Distribution; Workloads (psychophysiology);*

**N96-19461#** Wright Lab., Wright-Patterson AFB, OH. Avionics Directorate.

**Fiscal Year 1996 Avionics Technology Area Plan (TAP) Final Report**

Hunt, Wade T.; Aug. 1995 40 p

Contract(s)/Grant(s): (AF PROJ. 9993)

Report No.(s): (AD-A299043; WL-TR-96-1000) Avail: CASI HC A03/MF A01

The Avionics Technical Area Plan is the largest in the twelve Air Force Science and Technology programs. It describes the Avionics and Electronics exploratory and advanced development programs supporting all Air Force mission areas. The plan is divided into four thrust areas. The first thrust covers the area of Targeting and Attack Avionics which includes Radar and E-O Sensors, Automatic Target Recognition, and Fire Control. Thrust two covers Electronic Warfare, including Radar, C3, E-O and IR Countermeasures, Situation Awareness and Threat Alert, Multispectral Expendables, and Support Countermeasures. Thrust three covers System Avionics and includes Airborne Communications and Navigation, Signal and Data Processing, Embedded Software, Integrated Avionics, and Information Fusion. Thrust four, Electron Devices, covers Microelectronics, Microwaves, and Electro-Optics.

DTIC

*Airborne Equipment; Avionics; Countermeasures; Electro-optics; Electronic Equipment; Electronic Warfare; Military*

*Operations; Research and Development; Research Management;*

## 07 AIRCRAFT PROPULSION AND POWER

*Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.*

**N96-17819*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**The 3D Navier-Stokes analysis of a Mach 2.68 bifurcated rectangular mixed-compression inlet**
Mizukami, M.; and Saunders, J. D.; 1 Dec. 1995 11 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA
Contract(s)/Grant(s): (RTOP 537-02-22)
Report No.(s): (NASA-TM-107123; NAS 1.15:107123; E-10038; AIAA PAPER 96-0495; NIPS-96-07539) Avail: CASI HC A03/MF A01

The supersonic diffuser of a Mach 2.68 bifurcated, rectangular, mixed-compression inlet was analyzed using a three-dimensional (3D) Navier-Stokes flow solver. A two-equation turbulence model, and a porous bleed model based on unchoked bleed hole discharge coefficients were used. Comparisons were made with experimental data, inviscid theory, and two-dimensional Navier-Stokes analyses. The main objective was to gain insight into the inlet fluid dynamics. Examination of the computational results along with the experimental data suggest that the cowl shock-sidewall boundary layer interaction near the leading edge caused a substantial separation in the wind tunnel inlet model. As a result, the inlet performance may have been compromised by increased spillage and higher bleed mass flow requirements. The internal flow contained substantial waves that were not in the original inviscid design. 3D effects were fairly minor for this inlet at on-design conditions. Navier-Stokes analysis appears to be an useful tool for gaining insight into the inlet fluid dynamics. It provides a higher fidelity simulation of the flowfield than the original inviscid design, by taking into account boundary layers, porous bleed, and their interactions with shock waves.
Author
*Boundary Layer Separation; Boundary Layers; Computational Fluid Dynamics; Computational Grids; Engine Inlets; Flow Distribution; Internal Flow; Leading Edges; Navier-stokes Equation; Shock Wave Interaction; Shock Waves; Supersonic Diffusers; Three Dimensional Flow; Turbulence Models;*

**N96-17878*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**Calculation of kinetic rate constants from thermodynamic data**
Marek, C. John; et al 1 Dec. 1995 18 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA
Contract(s)/Grant(s): (RTOP 505-62-52)
Report No.(s): (NASA-TM-107124; NAS 1.15:107124; E-10043; AIAA PAPER 96-0218; NIPS-96-07540) Avail: CASI HC A03/MF A01

A new scheme for relating the absolute value for the kinetic rate constant k to the thermodynamic constant Kp is developed for gases. In this report the forward and reverse rate constants are individually related to the thermodynamic data. The kinetic rate constants computed from thermodynamics compare well with the current kinetic rate constants. This method is self consistent and does not have extensive rules. It is first demonstrated and calibrated by computing the HBr reaction from H2 and Br2. This method then is used on other reactions.
Author
*Chemical Reactions; Combustion Chemistry; Reaction Kinetics; Thermodynamics; Vapor Phases;*

**N96-18068*#** Purdue Univ., West Lafayette, IN.
**Laser Doppler velocimeter measurements and laser sheet imaging in an annular combustor model M.S. Thesis, Final Report**
Dwenger, Richard Dale; 1 Dec. 1995 285 p Original contains 12 color illustrations
Contract(s)/Grant(s): (NAS3-24350; RTOP 537-02-21)
Report No.(s): (NASA-CR-191060; NAS 1.26:191060; E-9866; NIPS-96-07712) Avail: CASI HC A13/MF A03

An experimental study was conducted in annular combustor model to provide a better understanding of the flowfield. Combustor model configurations consisting of primary jets only, annular jets only, and a combination of annular and primary jets were investigated. The purpose of this research was to provide a better understanding of combustor flows and to provide a data base for comparison with computational models. The first part of this research used a laser Doppler velocimeter to measure mean velocity and statistically calculate root-mean-square velocity in two coordinate directions. From this data, one Reynolds shear stress component and a two-dimensional turbulent kinetic energy term was determined. Major features of the flowfield included recirculating flow, primary and annular jet interaction, and high turbulence. The most pronounced result from this data was the effect the primary jets had on the flowfield. The primary jets were seen to reduce flow asymmetries, create larger recirculation zones, and higher turbulence levels. The second part of this research used a technique called marker nephelometry to provide mean concentration values in the combustor. Results showed the flow to be very turbulent and unsteady. All configurations investigated were highly sensitive to alignment of the primary and annular jets in the model

and inlet conditions. Any imbalance between primary jets or misalignment of the annular jets caused severe flow asymmetries.
Author
*Annular Flow; Combustion Chambers; Combustion Physics; Gas Flow; Gas Turbine Engines; Imaging Techniques; Jet Flow; Mathematical Models; Three Dimensional Flow; Turbulent Combustion; Turbulent Flow;*

**N96-18409*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**Evaluation of F/A-18A HARV inlet flow analysis with flight data Final Report**
Smith, C. Frederic; (NYMA, Inc., Brook Park, OH.)Podleski, Steve D.; (NYMA, Inc., Brook Park, OH.)Barankiewicz, Wendy S.; and Zeleznik, Susan Z.; (NYMA, Inc., Brook Park, OH.)1 Dec. 1995 96 p
Contract(s)/Grant(s): (NAS3-27186; RTOP 505-68-30)
Report No.(s): (NASA-TM-107130; NAS 1.15:107130; E-10056; NIPS-96-08122) Avail: CASI HC A05/MF A01

The F/A-18A aircraft has experienced engine stalls at high angles-of-attack and yaw flight conditions which were outside of its flight envelope. Future aircraft may be designed to operate routinely in this flight regime. Therefore, it is essential that an understanding of the inlet flow field at these flight conditions be obtained. Due to the complex interactions of the fuselage and inlet flow fields, a study of the flow within the inlet must also include external effects. Full Navier-Stokes (FNS) calculations on the F/A-18A High Alpha Research Vehicle (HARV) inlet for several angles-of-attack with sideslip and free stream Mach numbers have been obtained. The predicted forebody/fuselage surface static pressures agreed well with flight data. The surface static pressures along the inlet lip are in good agreement with the numerical predictions. The major departure in agreement is along the bottom of the lip at 30 deg and 60 deg angle-of-attack where a possible streamwise flow separation is not being predicted by the code. The circumferential pressure distributions at the engine face are in very good agreement with the numerical results. The variation in surface static pressure in the circumferential direction is very small with the exception of 60 angle-of-attack. Although the simulation does not include the effect of the engine, it appears that this omission has a second order effect on the circumferential pressure distribution. An examination of the unsteady flight test data base has shown that the secondary vortex migrates a significant distance with time. In fact, the extent of this migration increases with angle-of-attack with increasing levels of distortion. The effects of the engine on this vortex movement is unknown. This implies that the level of flow unsteadiness increases with increasing distortion. Since the computational results represent an asymptotic solution driven by steady boundary conditions, these numerical results may represent an arbitrary point in time. A comparison of the predicted total pressure contours with flight data indicates that the numerical results are within the excursion range of the unsteady data which is the best the calculations can attain unless an unsteady simulation is performed.
Author
*Angle of Attack; F-18 Aircraft; Flight Tests; Inlet Flow; Mach Number; Navier-stokes Equation; Prediction Analysis Techniques; Research Vehicles; Separated Flow; Sideslip; Static Pressure; Vortices; Yaw;*

**N96-18424*#** Allison Engine Co., Indianapolis, IN.
**TADS: A CFD-based turbomachinery and analysis design system with GUI. Volume 1: Method and results Final Report**
Topp, D. A.; Myers, R. A.; and Delaney, R. A.; 1 Dec. 1995 121 p
Contract(s)/Grant(s): (NAS3-25950; RTOP 505-62-10)
Report No.(s): (NASA-CR-198440; NAS 1.26:198440; E-10058; NIPS-96-08139) Avail: CASI HC A06/MF A02

The primary objective of this study was the development of a CFD (Computational Fluid Dynamics) based turbomachinery airfoil analysis and design system, controlled by a GUI (Graphical User Interface). The computer codes resulting from this effort are referred to as TADS (Turbomachinery Analysis and Design System). This document is the Final Report describing the theoretical basis and analytical results from the TADS system, developed under Task 18 of NASA Contract NAS3-25950, ADPAC System Coupling to Blade Analysis & Design System GUI. TADS couples a throughflow solver (ADPAC) with a quasi-3D blade-to-blade solver (RVCQ3D) in an interactive package. Throughflow analysis capability was developed in ADPAC through the addition of blade force and blockage terms to the governing equations. A GUI was developed to simplify user input and automate the many tasks required to perform turbomachinery analysis and design. The coupling of the various programs was done in such a way that alternative solvers or grid generators could be easily incorporated into the TADS framework. Results of aerodynamic calculations using the TADS system are presented for a highly loaded fan, a compressor stator, a low speed turbine blade and a transonic turbine vane.
Author
*Applications Programs (computers); Computational Fluid Dynamics; Computer Systems Design; Computer Systems Programs; Design Analysis; Graphical User Interface; Grid Generation (mathematics); Systems Analysis; Three Dimensional Flow; Turbomachinery;*

**N96-18687#** CFD Research Corp., Huntsville, AL.
**Advanced demonstration of fuel injector/flameholder for high speed ramburners Final Report**
Spring, S. A.; Smith, Clifford E.; and Leonard, Andy D.; May 1995 204 p

Contract(s)/Grant(s): (F33615-92-C-2288)
Report No.(s): (AD-A299064; WL-TR-96-2068) Avail: CASI HC A10/MF A03

The combustion efficiency of ramburner technology is mixing-limited. Therefore, significant gains are possible if the fuel-air mixing can be increased without a significant increase in pressure loss or a decrease in flame stability. Several design concepts were explored in this report that increase the fuel-air mixing by generating large axial vortices downstream of the flameholder. The baseline flameholder for this project was the Integral Fuel Injector/Flameholder (IFF) used in previous studies by United Technologies Research Center (UTRC). CFD solutions were completed on the baseline design and 28 advanced configurations. Most designs did improve fuel-air mixing, but also increased the cold pressure loss by several fold. The most promising designs used the momentum of the fuel to contribute to the axial thrust, thereby reducing the pressure loss. Isothermal experimental tests were conducted at Wright laboratory in parallel with CFD analysis. A complete data set was taken for one baseline model, while several advanced models were screened for pressure loss. The baseline tests showed that a regular pattern of alternating vortices were shed from the base of the flameholder.
DTIC
*Flame Holders; Flame Stability; Flames; Fuel Injection; Fuel-air Ratio; Position (location); Ramjet Engines; Vortices;*

**N96-18762#** Armstrong Lab., Brooks AFB, TX. Occupational and Environmental Health Directorate.
**C-130 engine compressor wash study, HQ ACC/CEV Final Report, Jan. - Mar. 1995**
Fronapfel, Paul J.; Oct. 1995 16 p
Report No.(s): (AD-A299862; AL/OE-TR-1995-0140) Avail: CASI HC A03/MF A01

This effort was conducted to characterize the waste stream from engine compressor washing operations on C-130 aircraft. Surveys at three bases were used to identify the levels of metals and other contaminants in the waste water. The report provides data which can assist bases in determining the best management plan for dealing with the compressor waste stream. HQ ACC/CEV funded this study.
DTIC
*C-130 Aircraft; Compressors; Contaminants; Washing; Waste Water;*

**N96-18819#** California Inst. of Tech., Pasadena, CA.
**Active control of instabilities in jet engines Final Report**
Doyle, John C.; 1994 31 p
Contract(s)/Grant(s): (N00014-92-J-1677)
Report No.(s): (AD-A298893) Avail: CASI HC A03/MF A01

Advances in several areas of robust control theory and its applications were made during the extension of this program. Our emphasis has been in the development of computable measures of performance robustness for both linear and nonlinear systems, and in the development of computationally sound identification algorithms. In the following paragraphs we briefly discuss the main areas of our program. A detailed description of the results obtained and the future directions to be explored follows. In the detailed description, we will point to the different publications that resulted from this research. Robust stability and performance analysis with real parametric uncertainty can be naturally formulated as a Structured Singular Value, or u problem, where the block structured uncertainty description is allowed to contain both real and complex blocks. It is now well known that computation for the general mixed u problem is NP complete. Thus, to obtain acceptable computation, we do not attempt to solve the mixed u problem exactly but rather to obtain good bounds. The key to obtaining a lower bound lies in the fact that the u problem may be reformulated as a real eigenvalue maximization since for any Q Q, pr(QMJ) less than u(Mi). The computational complexity of this problem manifests itself in the fact that this function is non-convex and so it is difficult to find the global maximum. Any local maximum, however, is a lower bound to the global maximum. We are currently working on an efficient way to compute a local maximum of the this function using a simple power iteration. We describe this algorithm in more detail in Section 3.
DTIC
*Active Control; Control Theory; Jet Engines; Linear Systems; Nonlinear Systems; Robustness (mathematics); Stability; Systems Engineering;*

**N96-19074*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. Combustion Lab.
**Influence of geometry and flow variations on NO formation in the quick mixer of a staged combustor**
Hatch, M. S.; (California Univ., Irvine, CA.)Sowa, W. A.; (California Univ., Irvine, CA.)Samuelsen, G. S.; (California Univ., Irvine, CA.)and Holdeman, J. D.; 1 Dec. 1995 3p Original contains 3 color illustrations
Contract(s)/Grant(s): (RTOP 537-02-20)
Report No.(s): (NASA-TM-105639; NAS 1.15:105639; E-6985; NIPS-96-07903) Avail: CASI HC A01/MF A01

Staged combustion, such as Rich-Burn/Quick-Mix/Lean-Burn (RQL), is a viable strategy to meet nitric oxide (NO) emission goals for both stationary and propulsion gas turbine engines. A critical element of the design is the quick mixer section where the potential for NO production is high. While numerical calculations of the quick mixer under reacting conditions have been conducted, the hostile environment and lack of appropriate diagnostics have, to date, precluded experimental probing of the reacting case. As an alternative

to understanding the effect of geometry and flow variations on the production of NO in the quick mixer, the present paper presents (1) a series of non-reacting parametric studies, and (2) a computational method to extrapolate the results of the non-reacting experiments to reacting conditions. The results show that the rate of NO production is highest in the immediate vicinity of the injection plane. For a given momentum flux ratio between the jets and mainstream, the most effective mixing geometry is that which mixes effectively in both (1) the plane of injection, and (2) the wall regions downstream of the plan of injection. The tailoring of the mixing is key to minimize the NO formed. As a result, the best overall mixer with respect to the minimization of NO production may depend on the system specific characteristics of the particular application.
Author
*Gas Turbine Engines; Nitric Oxide; Optimization; Propulsion;*

**N96-19121#** Georgia Inst. of Tech., Atlanta, GA. School of Industrial and Systems Engineering.
**Static and dynamic balance of rotor stacks Final Report, 1 May 1994 - 30 Apr. 1995**
Vandevate, John H.; and Bartholdi, III, John J.; 30 Apr. 1995 7 p
Contract(s)/Grant(s): (F49620-94-1-0232)
Report No.(s): (AD-A299409; AFOSR-95-0611TR) Avail: CASI HC A02/MF A01

A class of heuristic algorithms has been developed to guide the assembly of jet engine rotors in order to reduce static unbalance. These perform several orders of magnitude faster than those currently in use. Self-organizing logistics systems within warehouses were explored. A way was discovered to coordinate order-picking in a warehouse so that a balance of work among the pickers spontaneously emerges. In collaboration with Pratt & Whitney, a computer system is being developed that will use information about part geometry and mass distribution to predict the engine vibration from a given assembly and recommend a 'good' assembly that produces less vibration.
CASI
*Algorithms; Balance; Heuristic Methods; Jet Engines; Mistuning (turbomachinery); Rotary Stability; Rotors; Turbine Blades;*

**N96-19292*#** Missouri Univ., Rolla, MO.
**High-speed engine/component performance assessment using exergy and thrust-based methods**
Riggins, D. W.; 1 Jan. 1996 53 p
Contract(s)/Grant(s): (NAG1-1189; RTOP 505-70-69-03)
Report No.(s): (NASA-CR-198271; NAS 1.26:198271; NIPS-96-08930) Avail: CASI HC A04/MF A01

This investigation summarizes a comparative study of two high-speed engine performance assessment techniques based on energy (available work) and thrust-potential (thrust availability). Simple flow-fields utilizing Rayleigh heat addition and one-dimensional flow with friction are used to demonstrate the fundamental inability of conventional energy techniques to predict engine component performance, aid in component design, or accurately assess flow losses. The use of the thrust-based method on these same examples demonstrates its ability to yield useful information in all these categories. Energy and thrust are related and discussed from the stand-point of their fundamental thermodynamic and fluid dynamic definitions in order to explain the differences in information obtained using the two methods. The conventional definition of energy is shown to include work which is inherently unavailable to an aerospace Brayton engine. An engine-based energy is then developed which accurately accounts for this inherently unavailable work; performance parameters based on this quantity are then shown to yield design and loss information equivalent to the thrust-based method.
Author
*Brayton Cycle; Engine Parts; Engine Tests; Performance Tests; Supersonic Combustion Ramjet Engines; Thrust;*

**N96-19434** Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).
**SNECMA Scientific Revue, issue 5. English edition [Revue Scientifique SNECMA]**
Jun. 1994 74 p
Report No.(s): (PB96-101670) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

This issue of the SNECMA Scientific Revue focuses on the following study areas: Progress and New Challenges in Electronics and Digital Engine Control; Innovative Methods for Developing Electronic Control Systems; Development of a Mixed Finite Volume/Finite Element Method for Simulating Reactive Flows in Supersonic Combustors; Modeling Heat Transfers in Turbojet Combustors; Industrial Development of a New Superalloy N18 for Turbine Disks; and Probabilistic Model for Prediction of LCF Surface Crack Initiation in Powder Metallurgy Alloys.
NTIS
*Aircraft Engines; Combustible Flow; Control Systems Design; Digital Systems; Engine Control; Engine Starters; Finite Element Method; Heat Resistant Alloys; Powder Metallurgy; Turbines; Turbojet Engines;*

**N96-19460#** Wright Lab., Wright-Patterson AFB, OH. Aero Propulsion and Power Directorate.
**Fiscal Year 1996 aero propulsion and power Technology Area Plan (TAP) Final Report**
Jul. 1995 36 p
Contract(s)/Grant(s): (AF PROJ. 9993)
Report No.(s): (AD-A299042; WL-TR-96-2000) Avail: CASI HC A03/MF A01

The Aero Propulsion and Power Technology Area is responsible for developing air breathing propulsion and power technology for Air Force use. Besides developing new technologies, product centers are supported by helping acquire systems and providing expertise to help solve developmental problems. Current research and development includes aircraft gas turbine engines (components, gas generators, technology demonstrator engines, fuels and lubricants) , missile propulsion, (solid fuel ramjets, ducted rockets, and small turbine engines), aircraft and missile power (electrical and mechanical power generation, conditioning and distribution, energy storage, and thermal management), and plasma physics. Work is conducted primarily under contract, although an aggressive in-house program exploits new opportunities, maintains technical expertise, and verifies contractor findings. Supporting this are two dozen major in-house R&D facilities and an annual budget of over $150 million.
DTIC
*Air Breathing Engines; Aircraft Engines; Engine Design; Power Conditioning; Propulsion System Configurations; Research and Development; Research Management;*

## 08 AIRCRAFT STABILITY AND CONTROL

*Includes aircraft handling qualities; piloting; flight controls; and autopilots.*

**N96-18186** Wayne State Univ., Detroit, MI.
**Nonlinear flutter of composite panel under aerodynamic heating Ph.D. Thesis**
Abbas, Jehad Fawaz; 1993 202 p Avail: Univ. Microfilms Order No. DA9418117

Linear and nonlinear analytical model for typical aerothermoelastic composite structure, such as a panel, have been formulated. The panel was represented as a thin plate with one side exposed to a supersonic air flow and subjected to aerodynamic heating. Reissner's variational theorem together with Hamilton's principle and the variational calculus was utilized to derive a system of different equations which describes the interactions of elastic, thermal, and aerodynamic forces of generally orthotropic laminated composite panels. These equations were reduced to a system of two partial differential equations for the lateral displacement and stress function. These two coupled nonlinear differential equations were solved for the case of isotropic, 0 deg orthotropic and 90 deg orthotropic panels including the effects of aerodynamic heating. Work done by aerodynamic forces was represented by using the 'piston' theory for two dimensional lifting surfaces. The aerodynamic heating effect was estimated based on the adiabatic wall temperature due to the high speed airstream. Galerkin's method was applied to convert the partial differential equation of motion into a system of coupled nonlinear ordinary differential equations for the model-amplitude. The direct numerical integration of the six coupled nonlinear differential equations was performed by using the IMSL-DIPAG subroutine. The aerodynamic behavior of three different panel materials exposed to high speed air flow is investigated. The panel materials considered are isotropic (steel), 0 deg and 90 deg orthotropic (graphite/epoxy). Both flutter analysis and nonlinear response characteristics were examined. For simply supported panels and where only the interaction of the six modes is considered, it is shown that aerodynamic heating enhances the occurrence of flutter at lower aerodynamic pressure. Aerodynamic heating also results in panel buckling, especially for isotropic and 90 deg orthotropic panels. As the panel approaches the onset of buckling, the nonlinear response yields complex characteristics including period doubling and chaos. The development of chaos is examined in the time domain and in terms of statistical response parameters such as power spectra and probability density functions. The mathematical modeling of specially orthotropic panels including structural damping was formulated and the effect of structural damping was examined for the cases of heated and unheated panels made of isotropic, 0 deg orthotropic and 90 deg orthotropic materials. The damped natural frequencies was computed numerically by using the IMSL subroutine EVLCG. The structural damping reduced the critical value of aerodynamic pressure parameter by 0.4, 0.5, and 0.2 for isotropic, 90 deg orthotropic and 0 deg orthotropic panels, respectively. It was clear that the structural damping has drastic destabilizing effect on the critical aerodynamic pressure parameter lambda(sub cr) in the case of 90 deg orthotropic panels and somewhat more less in the case of 0 deg orthotropic panesls.
Dissert. Abstr.
*Aerodynamic Forces; Aerodynamic Heating; Aerothermoelasticity; Flutter Analysis; Laminates; Mathematical Models; Orthotropic Plates; Panel Flutter; Supersonic Flutter;*

**N96-18304#** Centre National de la Recherche Scientifique, Toulouse (France).
**How fuzzy logic can help manual flight control c08**
Mora-Camino, F.; and Achaibou, A. K.; In INPE, IFSA 1995: Proceedings of the 6th International Fuzzy Systems Association World Congress, Volume 1 28 Jul. 1995 p 417-419 (For primary document see N96-18292 05-67) Avail: CASI HC A01/MF A06

In the communication we investigate what can be expected from fuzzy logic to build intelligent flight directors to improve the help they provide, in an automatic way, to manual control for the flight of modern civil transportation aircraft.
Author

*Aircraft Control; Control Theory; Flight Control; Fuzzy Systems; Manual Control;*

**N96-18309#** Gyron Tecnologia, Campinas (Brazil).
**A transputer forth based fuzzy inference machine for helicopter guidance c08**
Ramos, Josue J. G.; Dasilva, Pedro Paulo; (Universidade Federal de Sao Carlos, Brazil.)Bittencourt, Guilherme; (Universidade Federal de Sao Carlos, Brazil.)and Seibel, Conrado W.; (Gyron Tecnologia, Florianopolis, Brazil.)In INPE, IFSA 1995: Proceedings of the 6th International Fuzzy Systems Association World Congress, Volume 1 28 Jul. 1995 p 541-544 (For primary document see N96-18292 05-67) Avail: CASI HC A01/MF A06

Fuzzy control has shown to be useful in handling nonlinear systems and ill-defined or imprecise problems that depend on the operator skill, as in the case of helicopters. This paper presents the implementation of a Fuzzy Inference Machine that runs in a Forth-Based Transputer environment. This work corresponds to the second step of a feasibility analysis for the implementation of a fuzzy inference machine in the system on board of an unmanned helicopter developed by Gyron Tecnologia. The system organization is described, along with the fuzzy inference machine design and the results obtained with the integration of the real inference machine to a helicopter simulation system. The results were compared with the previous simulated results for hover flights.
Author
*Aircraft Guidance; Flight Control; Fuzzy Systems; Helicopter Control; Inference; Pilotless Aircraft; Remote Control; Transputers;*

**N96-18516*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**Differential Canard deflection for generation of yawing moment on the X-31 with and without the vertical tail M.S. Thesis - George Washington Univ.**
Whiting, Matthew Robert; 9 Jan. 1996 166 p
Report No.(s): (NASA-TM-111357; NAS 1.15:111357; NIPS-96-08402) Avail: CASI HC A08/MF A02

The feasibility of augmenting the available yaw control power on the X-31 through differential deflection of the canard surfaces was studied as well as the possibility of using differential canard control to stabilize the X-31 with its vertical tail removed. Wind-tunnel tests and the results of departure criteria and linear analysis showed the destabilizing effect of the reduction of the vertical tail on the X-31. Wind-tunnel testing also showed that differential canard deflection was capable of generating yawing moments of roughly the same magnitude as the thrust vectoring vanes currently in place on the X-31 in the post-stall regime. Analysis showed that the X-31 has sufficient aileron roll control power that with the addition of differential canard as a yaw controller, the wind-axis roll accelerations will remain limited by yaw control authority. It was demonstrated, however, that pitch authority may actually limit the maximum roll rate which can be sustained. A drop model flight test demonstrated that coordinated, wind axis rolls could be performed with roll rates as high as 50 deg/sec (full scale equivalent) at 50 deg angle of attack. Another drop model test was conducted to assess the effect of vertical tail reduction, and an analysis of using differential canard deflection to stabilize the tailless X-31 was performed. The results of six-degree-of-freedom, non-linear simulation tests were correlated with the drop model flights. Simulation studies then showed that the tailless X-31 could be controlled at angles of attack at or above 20 deg using differential canard as the only yaw controller.
Author
*Canard Configurations; Directional Control; Drop Tests; Tail Assemblies; Wind Tunnel Tests; X-31 Aircraft Yaw;*

**N96-18529#** Universitaet der Bundeswehr Muenchen, Neubiberg (Germany).
**Functional development and field test of CASSY: A knowledge-based cockpit assistant system c08**
Onken, R.; In AGARD, Knowledge-Based Functions in Aerospace Systems 1 Nov. 1995 22 p (For primary document see N96-18527 05-63) Avail: CASI HC A03/MF A02

This paper presents the functional concept and development of the cockpit assistant system CASSY, based on basic requirements for effective man/machine interaction. This system was developed in order to enhance flight safety and mission effectiveness. The time has come that cockpit systems will no longer be designed on a vague basis of specifications. The advances in technology provide the necessary basis to systematically reflect requirements for human-centered automation into clear-cut specifications and system design. CASSY is developed as a knowledge-based system. It has been extensively tested in flight simulators as well as field tested in the ATTAS (Advanced Technologies Test Aircraft System) of the DLR. Some of the results of these flight trials will be presented in this paper. The development was conducted by the University of the German Armed Forces, Munich with some support by DASA.
Author
*Aircraft Guidance; Aircraft Instruments; Expert Systems; Flight Instruments; Flight Safety;*

**N96-18530#** Dassault Aviation, Saint-Cloud (France).
**Development environment for knowledge-based systems. Some examples of application: The Copilote Electronique Project c08**
Champigneux, G.; In AGARD, Knowledge-Based Functions in Aerospace Systems 1 Nov. 1995 10 p (For primary document see N96-18527 05-63) Avail: CASI HC A02/MF A02

This paper aims at describing first lessons learnt in terms of engineering guidelines and development methodology within the french project called 'Copilote Electronique' of an Electronic Crew Member System. This project is lead by Dassault Aviation with the support of French official services (DRET, STTE) and involves several industrial and scientific partners (SAGEM, Dassault Electronique, Matra Defense, Sextant Avionique, IMASSA). The French 'Copilote Electronique' project started in 1986 through various preliminary studies and since 1994 it has taken a larger scale under the form of an exploratory development. Before the start of this development, advantages and drawbacks of existing software engineering or knowledge acquisition methodologies were compared. Emphasis was put on ergonomics design rules and on a project life cycle adaptation aiming at insuring better responses to pilots demands and fears. Building on the first year experience of the exploratory development phase of the Copilote Electronique project, we express confidence for successful operational evaluations.
Derived from text
*Automatic Pilots; Expert Systems; Knowledge Bases (artificial Intelligence); Product Development;*

**N96-18736*#** Lockheed Martin Engineering and Sciences Co., Hampton, VA.
**Using the HARV simulation aerodynamic model to determine forebody strake aerodynamic coefficients from flight data**
Messina, Michael D.; 1 Dec. 1995 17 p
Contract(s)/Grant(s): (NAS1-19000; RTOP 505-68-30-05)
Report No.(s): (NASA-CR-198247; NAS 1.26:198247; NIPS-96-08492) Avail: CASI HC A03/MF A01

The method described in this report is intended to present an overview of a process developed to extract the forebody aerodynamic increments from flight tests. The process to determine the aerodynamic increments (rolling pitching, and yawing moments, Cl, Cm, Cn, respectively) for the forebody strake controllers added to the F/A - 18 High Alpha Research Vehicle (HARV) aircraft was developed to validate the forebody strake aerodynamic model used in simulation.
Author
*Aerodynamic Characteristics; Aerodynamic Coefficients; Flight Simulation; Flight Tests; Forebodies; Strakes; Yawing Moments;*

**N96-18766#** Air Force Systems Command, Wright-Patterson AFB, OH. National Air Intelligence Center.
**ACTA aeronautica et astronautica sinica (Selected articles)**
1 Aug. 1995 40 p Transl. into ENGLISH from Hangkong Xuebao (China), v. 13, no. 12, 1992 p 670-677
Report No.(s): (AD-A299901; NAIC-ID(RS)T-0587-93) Avail: CASI HC A03/MF A01

This report reviews the following two articles: (1) The doppler radar imaging techniques; (2) The adaptive angle control method of terrain following. The first article discusses a method that utilized a regularized image reconstruction and dynamic optimization algorithm to solve the least square estimate of the reflectivity of a radar target. This approach improves the resolution of a doppler radar image. The second article discusses the development of terrain following technology that utilized an adaptive angle control method.
CASI
*Adaptive Control; Doppler Radar; Flight Control; Image Reconstruction; Imaging Techniques; Radar Imagery; Terrain Following;*

**N96-18896#** Advanced Rotorcraft Technology, Inc., Mountain View, CA.
**Rotorcraft handling qualities and flight control system specification personal computer tutorial and data base Final Report**
Duval, Ronald W.; He, Chengjian; Jung, Yoon; Choi, Keeyoung; and English, Joe; 14 Feb. 1995 42 p
Contract(s)/Grant(s): (N00600-94-C-3074)
Report No.(s): (AD-A300217) Avail: CASI HC A03/MF A01

It is essential to have a continuing training program for updating handling quality and flight test engineers, and flight test pilots with ongoing changes in flying qualities specifications, flight control system design, and flight test technology. The demanding schedule of these practicing professionals makes it difficult to attain the training from a conventional classroom environment. A computer aided tutorial is an efficient tool to provide this self-learning in a cost effective way. It offers flexibility for on-the- job training and is also a valuable analysis tool. With today's computer power and modern programming technology, an interactive presentation of the training materials is straightforward. The text, figures, and mathematical equations can all be displayed with textbook quality. A computer tutorial typically follow the lesson plan of a formal training class, but with interactive examples to facilitate learning by active involvement of the students. Due to its low cost and easy maintenance, a PC is readily available to all professional at the office and at home. Although there are still limitations in the PC's memory and computational power, recent advances in network technology have allowed PC's to act as smart terminals and remotely access more powerful, UNIX based computers and workstations. Today's PC can even emulate the X-window graphical interfaces of the workstations. A tutorial that utilizes the X-Terminal emulation capability of a PC can combine locally based tutorial sessions with remotely accessed data bases, simulations, and analysis utilities, resulting in a powerful desktop learning tool.
DTIC

*Aircraft Performance; Aircraft Specifications; Control Systems Design; Controllability; Data Bases; Education; Flight Characteristics; Flight Control; Flight Tests; Personal Computers; Rotary Wing Aircraft;*

**]N96-19138#** University of Southern California, Los Angeles, CA. Dept. of Aerospace Engineering.
**Aerodynamic flow vectoring of wakes Final Report, 15 Jul. 1992 - 15 Jul. 1994**
Redekopp, Larry G.; 8 Dec. 1994 5 p
Contract(s)/Grant(s): (F49620-92-J-0377; AF PROJ. 2307)
Report No.(s): (AD-A299313; AFOSR-95-0630TR) Avail: CASI HC A01/MF A01

The concepts of flow vectoring have long been established through the use of mechanical moving surfaces such as ailerons, elevators, flaps, etc. to redirect the local flow on an aircraft in order to obtain high-lift control and thrust-vectoring. Only recently has aerodynamic flow vectoring been investigated whereby the flow may be redirected without any movable surfaces. The present study has addressed the open loop control of a wake by means of trailing edge suction to enhance, or introduce any asymmetry of the mean flow of the wake to produce aerodynamic flow vectoring.
DTIC
*Aerodynamic Characteristics; Aerodynamic Configurations; Control Surfaces; Fluid Flow; Lift; Thrust Vector Control; Wakes;*

**N96-19685#** Johns Hopkins Univ., Baltimore, MD.
**Gain scheduling for robust linear controllers Final Report, 1 Mar. 1993 - 30 Jun. 1995**
Rugh, Wilson J.; Aug. 1995 6 p
Contract(s)/Grant(s): (F49620-93-1-0170)
Report No.(s): (AD-A299160; AFOSR-95-0587TR) Avail: CASI HC A02/MF A01

Results of research on a theory of gain scheduling for flight control applications include the development of a solution to an input-output pseudolinearization problem for nonlinear systems, characterization of the impact of linear controller configuration on the gain scheduling process, and formulation of an approach to gain scheduling in the face of rapidly varying scheduling signals. Publications describing the results in detail are listed.
DTIC
*Control Systems Design; Control Theory; Controllers; Flight Control; Scheduling;*

## 09 RESEARCH AND SUPPORT FACILITIES (AIR)

*Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.*

**N96-17751#** CSC Professional Services Group, Falls Church, VA.
**Innovative approach to development of a variable configuration multisensor test capability Final Technical Report, Mar. - Oct. 1994**
Bright, Gerald A.; Mandry, Robert S.; and Barnell, Mark D.; Jul. 1995 32 p
Contract(s)/Grant(s): (F30602-94-C-0058; AF PROJ. 2304)
Report No.(s): (AD-A299825; RL-TR-95-120) Avail: CASI HC A03/MF A01

Rome Laboratory (RL) OCSM directorate is actively developing a Multisensor Data Fusion Tracking Testbed capability for evaluating, testing, and developing fusion algorithms. This report describes the work performed by CSC Professional Services Group to improve this testbed, install the University of Connecticut's Multisensor Air Traffic Surveillance (MATSurv) Tracking Algorithm, and validate the algorithm's performance. The MATSurv algorithm is the result of RL's efforts to transition data association and estimation algorithms, developed as part of AFOSR funded research, out of the university environment and into the field for test and evaluation. The testbed is unique in that it provides a menu driven variable configuration capability that allows researchers to configure the software and hardware resources. The resources include data sources, data processing components, and display devices configurable into real world combinations. Thus, the testbed provides a framework for the evaluation and modification of abstract methods of combining multiple sources of data into fused tracks.
DTIC
*Air Traffic; Algorithms; Configurations; Data Processing Equipment; Multisensor Fusion; Signal Processing; Surveillance;*

**N96-18575#** Armstrong Lab., Wright-Patterson AFB, OH. Crew Systems Directorate.
**Coriolis study of the dynamic environment simulator Final Report, Oct. 1990 - Apr. 1995**
Reppeerger, Daniel W.; Apr. 1995 32 p
Contract(s)/Grant(s): (AF PROJ. ILI-R)
Report No.(s): (AD-A299190; AL/CF-TR-1995-0043) Avail: CASI HC A03/MF A01

A three axis motion simulator is modeled as a robotic manipulator. The equations of motion are derived and the terms due to Coriolis are quantified. Two optimization algorithms are presented to minimize the Coriolis produced in the simulator at the end effector. It is shown with minimal reduction of motion fidelity, that over 65 percent of Coriolis can be reduced with proper input commands to modify the

motion field produced. When this reduction of Coriolis is realized, the motion fidelity is only compromised about 5 percent which may not be perceivable by the human subjects that participate in the human runs in the mechanical system considered herein.
DTIC
*Coriolis Effect; Dynamical Systems; End Effectors; Equations of Motion; Flight Simulators; Manipulators; Mathematical Models; Motion Simulators; Robot Dynamics;*

**N96-18576#** Naval Postgraduate School, Monterey, CA.
**A flexible plate nozzle design for an operating mach number range of 1.4 to 2.0 M.S. Thesis**
Emmert, Terence G.; Mar. 1995 175 p
Report No.(s): (AD-A299194) Avail: CASI HC A08/MF A02

The design for a supersonic flexible plate nozzle is presented. The nozzle was required for a supersonic blow-down cascade wind tunnel facility at the Naval Postgraduate School's Gas Dynamics Laboratory. Overall dimensions were based on calculations of the required test section height and width which would give acceptable (2 minute) mn times over an operating Mach number range from 1.4 to 2.0. A two-dimensional, constant-plate thickness, multiple-jack screw configuration was the concept used to effect the nozzle geometry changes. Mention is made of a multi-disciplinary design optimization routine which helped to rule out a single-jack, variable-plate thickness configuration. The aerodynamic and structural analysis used in the design process is presented in detail. Preliminary drawings of the nozzle mechanism are included.
DTIC
*Aerodynamic Configurations; Air Flow; Cascade Wind Tunnels; Computational Fluid Dynamics; Design Analysis; Finite Element Method; Flow Distribution; Mach Number; Nozzle Design; Nozzle Geometry; Structural Analysis; Supersonic Flow; Supersonic Nozzles; Supersonic Wind Tunnels;*

**N96-19288*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**The NASA Langley 16-foot Transonic Tunnel: Historical overview, facility description, calibration, flow characteristics, and test capabilities**
Capone, Francis J.; Bangert, Linda S.; Asbury, Scott C.; Mills, Charles T. L.; and Bare, E. Ann; 1 Sep. 1995 204 p
Contract(s)/Grant(s): (RTOP 505-59-30-04)
Report No.(s): (NASA-TP-3521; NAS 1.60:3521; L-17445; NIPS-96-08515) Avail: CASI HC A10/MF A03

The Langley 16-Foot Transonic Tunnel is a closed-circuit single-return atmospheric wind tunnel that has a slotted octagonal test section with continuous air exchange. The wind tunnel speed can be varied continuously over a Mach number range from 0.1 to 1.3. Test-section plenum suction is used for speeds above a Mach number of 1.05. Over a period of some 40 years, the wind tunnel has undergone many modifications. During the modifications completed in 1990, a new model support system that increased blockage, new fan blades, a catcher screen for the first set of turning vanes, and process controllers for tunnel speed, model attitude, and jet flow for powered models were installed. This report presents a complete description of the Langley 16-Foot Transonic Tunnel and auxiliary equipment, the calibration procedures, and the results of the 1977 and the 1990 wind tunnel calibration with test-section air removal. Comparisons with previous calibrations showed that the modifications made to the wind tunnel had little or no effect on the aerodynamic characteristics of the tunnel. Information required for planning experimental investigations and the use of test hardware and model support systems is also provided.
Author
*Aerodynamic Characteristics; Flow Characteristics; Mach Number; Test Chambers; Transonic Wind Tunnels; Wind Tunnel Calibration;*

## 10 ASTRONAUTICS

*Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.*

**N96-18903#** Naval Air Warfare Center, Patuxent River, MD. Aircraft Div.
**RTPS telemetry: Simulator link at Naval Air Warfare Center**
McNamara, William G.; Stanley, Page; and Nichols, Jay; 25 Aug. 1995 9 p
Report No.(s): (AD-A300647) Avail: CASI HC A02/MF A01

Over the last 3 years the Naval Air Warfare Center Aircraft Division (NAWCAD), Patuxent River, MD has been in the process of developing a link between its secure Manned Flight Simulator (MFS) and Real Time Processing System (RTPS) facilities. The MFS hosts a wide variety of high fidelity fixed and rotary wing aircraft simulation models. The RTPS is used as a telemetry ground station for conduct of Navy flight testing at Patuxent River MD. The ability to integrate simulation with flight testing in a real time environment provides new potential for increased flight safety, enhanced engineering training, optimized flight test planning, real time simulation fidelity assessments, improved engineering analysis and other applications for enhanced flight testing, data analysis and data processing. A prototype system has been successfully designed and operated at NAWCAD in support of an F/A-18C flight test project which re-

quired simultaneous merging and display of real time and simulation data to reduce the risk of departure from controlled flight. As currently designed the link (encryption and decryption gear in the loop) can be operated in three modes: (1) Simulation sending data to RTPS (e.g. pilot-engineer pre-first flight preparation/training scenario; (2) simulation is driven by real aircraft control surface inputs and response is compared with that of the real aircraft for simulation fidelity assessments; and (3) simulation 'rides along' with the real aircraft and data are extracted from the simulation which are otherwise unavailable from the aircraft (e.g. flight control law interconnect signals, control law feedback signals, aerodynamic data, propulsion model data, avionics model data, other model data etc.). This paper discusses, design and implementation aspects of the RTPS-Simulator link, and includes a description of how the link was used to support a real time flight test program by providing critical safety of flight data. Other potential uses for the link will also be highlighted.
DTIC
*Aircraft Configurations; Aircraft Models; Computerized Simulation; Fixed Wings; Flight Simulators; Flight Tests; Ground Stations; Navy; Real Time Operation; Rotary Wing Aircraft; Telemetry;*

## 11 CHEMISTRY AND MATERIALS

*Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.*

**N96-18407*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**High temperature composites**
Nathal, M. V.; 1 Dec. 1995 12 p Presented at the International Workshop on Ordered Intermetallic Alloys and Composites, Beijing, China, 27 Jun. 1995; sponsored by DOE and DOD
Contract(s)/Grant(s): (RTOP 505-63-5A)
Report No.(s): (NASA-TM-107127; NAS 1.15:107127; E-10050; NIPS-96-08121) Avail: CASI HC A03/MF A01

The purpose of this paper is to review the current state of the development of new composite materials for advanced aircraft engines. The advantages and disadvantages of Ti-base, NiAl-base, and MoSi2-base composites as replacements for today's Ni-base superalloys are discussed from the standpoint of key technical issues, current status, and future directions. Results describing progress in both improved understanding of the mechanisms of deformation and fracture, and improved material performance will be covered.
Author
*Aircraft Construction Materials; Aluminum Alloys; Heat Resistant Alloys; Metal Matrix Composites; Molybdenum Alloys; Nickel Alloys; Refractory Metals; Silicides; Technology Assessment; Titanium Alloys;*

**N96-18900#** Arnold Engineering Development Center, Arnold AFS, TN.
**Demonstrations of a pressure sensitive paint data system in the AEDC propulsion wind tunnel 16T Final Report, Oct. 1993 - Oct. 1994**
Sellers, M. E.; Oct. 1995 58 p Limited Reproducibility: Document partially illegible
Report No.(s): (AD-A300236; AEDC-TR-95-8) Avail: CASI HC A04/MF A01

A prototype Pressure Sensitive Paint (PS P) data system was assembled to demonstrate the capability to acquire and process surface pressure date using PSP in the AFDC Propulsion Wind Tunnel 16T. The first test was preformed on a 1/10-scale model of the Dornier Alpha Jet with a Transonic Technology (TST) Wing to obtain PSP data for comparison with conventional pressure measurements and Computational Fluid Dynamics (CFD) results. The second test was performed on a 15-percent scale model of the F-18 ElF to obtain PSP data on the upper and lower surface of the F-18 horizontal tail for comparison with conventional pressure measurements. Also, the PSP data were integrated to obtain loads on the horizontal tail for comparison with conventional pressure-integrated and balance-measured loads. A paint formulation developed at AEDC was used in the tests. Some of the unique features of the paint are discussed, and details of the data acquisition and reduction system are presented. The data system was controlled by the facility computer, which acquired PSP data automatically. The digitized images were processed to obtain qualitative images of the surface pressure distribution within minutes of acquisition. The images were processed further after the tests to obtain quantitative pressure data. Comparisons with measured pressure data, CFD solutions (TST only), and measured and integrated loads (F-18 only) are presented.
DTIC
*Computational Fluid Dynamics; Data Acquisition; Data Reduction; Data Systems; Extremely Low Frequencies; Loads (forces); Paints; Pressure Measurement; Propulsion; Prototypes; Scale Models; Sensitivity; Wind Tunnels;*

**N96-19415#** Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
**Demonstration of noncyanide strippers to replace cyanide strippers, part 1 Final Report, Jan. - Sep. 1990**
Argyle, M. D.; Cowan, R. L.; Fox, R. V.; Groenewold, G. S.; Janikowski, S. K.; and Martinez, R. S.; Mar. 1995 222 p
Contract(s)/Grant(s): (DE-AC07-76ID-01570)
Report No.(s): (AD-A299396; EGG-WTD-10087-PT-1; AFCESA/ESL-TR-92-12-PT-1) Avail: CASI HC A10/MF A03

This report is divided into parts. Part 1 consists of the front matter, text, and Appendixes A through F; part 2 consists of Appendixes G through K. The objective was to develop and demonstrate an improved means to replace cyanide-containing metal stripping solution in the plating shops at the Air Logistics Centers. During the program, 35 commercial strippers, 3 Air Force process solutions, and a generic nickel stripper were tested. First, these strippers were evaluated on a laboratory scale. If a stripper proved worthwhile in the laboratory, it then was scaled up in a field test. The next step was to implement the most worthwhile products into the plating shop at Kelly AFB. Two strippers, B-9 Nickel Stripper and Rostrip 999-sp Electrolytic Silver stripper, have been successful and implemented into the plating shop at Kelly.
DTIC

*Biodegradability; Chemical Compatibility; Metal Coatings; Nickel; Removal; Silver;*

**N96-19624#** California Univ., San Diego, La Jolla, CA.
**Theories of turbulent combustion in high speed flows Final Technical Report**
Libby, P. A.; and Williams, F. A.; 13 Jun. 1995 11 p
Contract(s)/Grant(s): (F49620-92-J-0184; AF PROJ. 2308)
Report No.(s): (AD-A299347; AFOSR-95-0583TR) Avail: CASI HC A03/MF A01

This research involved theoretical studies of the chemical and fluid-mechanical phenomena which make turbulent combustion in high-speed flows different from such combustion in low-speed flows. Finite-rate chemistry plays a significant role in high-speed flows because of the small ratios of flow times to chemical times. The studies addressed ignition and extinction phenomena in nonpremixed turbulent combustion of hydrogen-air systems by both numerical and asymptotic methods. Efforts were made to provide a firmer foundation for the modeling of high-speed turbulent reacting flows, to aid in the development of a formulation which gives results that can be compared with experiments on turbulent combustion. It was shown that turbulent combustion occurs in the reaction-sheet regime in hypersonic propulsion, and the correspondingly needed critical ignition and extinction conditions for hydrogen-air systems were determined from fundamentals.
DTIC

*Diffusion Flames; Ignition; Supersonic Combustion; Turbulent Combustion; Turbulent Flow;*

**N96-19719#** Ibis Associates, Inc., Wellesley, MA.
**Titanium matrix composite processing: Tapecast preforms Interim Technical Report No. 3, 1 Sep. 1993 - 31 Aug. 1995**
Busch, John V.; 31 Aug. 1995 11 p
Contract(s)/Grant(s): (N00014-93-C-0210)
Report No.(s): (AD-A300004) Avail: CASI HC A03/MF A01

Titanium matrix composites (TMC's) would enable significant advances in commercial and military aviation product design, yet at the present there has been little implementation into promising engine applications. In general, economical processing technologies and reinforcing fibers are not yet available. This report focuses on evaluating the economic potential of one promising technology to produce TMC preforms. This process, known as tapecasting, has been developed at Textron Specially Materials (Lowell, MA). The endproduct of this process is a long, thin tape of titanium metal and silicon carbide fibers which is further processed to produce bar stock TMC product. This analysis identifies the conditions under which this process becomes economically feasible on a commercial scale, and evaluates specific options for potential cost reduction. The conclusions drawn from this indicate the dominance of fiber price on total cost, which is independent of the manufacturing process. Process variables such as wind speed, yield, scrap, and labor rate all have a marginal effect on total cost, leaving low potential for cost reduction in these areas. The analysis demonstrates that a commercially viable TMC tape preform can be realized as long as the fiber cost drops accordingly.
DTIC

*Aircraft Engines; Costs; Economic Analysis; Manufacturing; Matrix Materials; Metal Matrix Composites; Preforms; Reinforcing Fibers; Titanium;*

**N96-19724#** Air Force Systems Command, Wright-Patterson AFB, OH. National Air Intelligence Center.
**HDO3 composite materials: Applications and development**
Jian, Zhang M.; 18 Aug. 1995 13 p Transl. into ENGLISH from Aviation Production Engineering (China), Issue 12, 13p, 1993
Report No.(s): (AD-A300555; NAIC-ID(RS)T-0204-95) Avail: CASI HC A03/MF A01

The HDO3 matrix is a composite-resin matrix solidified at 170 deg. F, researched and developedin the early 1980s. Due to its excellent processing and outstanding properties, it became the matrix used for the carbon-fiber-reinforced plastic (CFRP), acrylic-fiber-reinforced plastic (AFRP) and graphite-fiber-reinforced plastic (GFRP) used in many types of aircraft. Twenty-four types of components have already been produced, and from installation and test flight in 1985 to now, have more than seven years flight experience with these materials.
DTIC

*Carbon Fiber Reinforced Plastics; Carbon Fibers; Fiber Composites; Glass Fiber Reinforced Plastics;*

## 12 ENGINEERING

*Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.*

**N96-17811*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**Planar imaging of hydroxyl in a high temperature, high pressure combustion facility**

Hicks, Yolanda R.; Locke, Randy J.; (NYMA, Inc., Brook Park, OH.)Anderson, Robert C.; and Ockunzzi, Kelly A.; (Ohio Aerospace Inst., Cleveland, OH.)1 Oct. 1995 11 p Presented at the International Symposium on Optical Science, Engineering and Instrumentation, San Diego, CA, United States, 9-14 Jul. 1995; sponsored by Society of Photo-Optical Instrumentation Engineers Originial contains 2 color illustrations

Contract(s)/Grant(s): (NAS3-25266; RTOP 537-02-20)

Report No.(s): (NASA-TM-107074; NAS 1.15:107074; E-9938; NIPS-96-07532) Avail: CASI HC A03/MF A01

An optically accessible flame tube combustor is described which has high temperature, pressure, and air flow capabilities. The windows in the combustor measure 3.8 cm axially by 5.1 cm radially, providing 67 percent optical access to the square cross section flow chamber. The instrumentation allows one to examine combusting flows and combustor subcomponents, such as fuel injectors and air swirlers. These internal combustor subcomponents have previously been studied only with physical probes, such as temperature and species rakes. Planar laser-induced fluorescence (PLIF) images of OH have been obtained from this lean burning combustor burning Jet-A fuel. These images were obtained using various laser excitation lines of the OH A yields X (1,0) band for two fuel injector configurations with pressures ranging from 1013 kPa (10 atm) to 1419 kPa (14 atm), and equivalence ratios from 0.41 to 0. 59. Non-uniformities in the combusting flow, attributed to differences in fuel injector configuration, are revealed by these images.
Author

*Air Flow; Aircraft Engines; Combustible Flow; Combustion Efficiency; Diffusion Flames; Gas Turbine Engines; High Temperature Air; Hydroxyl Radicals; Image Analysis; Laser Induced Fluorescence; Premixed Flames; Supersonic Aircraft; Supersonic Combustion;*

**N96-17908#** Solar Turbines, Inc. San Diego, CA.

**Ceramic stationary gas turbine development Final Report**

Sep. 1994 225 p

Contract(s)/Grant(s): (DE-AC02-92CE-40960)

Report No.(s): (DE95-017793; DOE/CE-40960/T2) Avail: CASI HC A10/MF A03

This report summarizes work performed by Solar Turbines Inc. and its subcontractors during the period 25 Sept. 1992 - 30 Apr. 1993. The objective of the work is to improve the performance of stationary gas turbines in cogeneration through implementation of selected ceramic components.
DOE

*Ceramics; Cogeneration; Construction Materials; Design Analysis; Gas Turbines; Turbine Engines;*

**N96-17927** Department of the Navy, Washington, DC.

**On demand, non-halon, fire extinguishing systems Patent**

Smith, Benjamin D.; inventor (to Navy)20 Jun. 1995 10 p Filed 23 Jun. 1993. Supersedes AD-D015957

Report No.(s): (AD-D017662; US-PATENT-5,425,886; US-PATENT-APPL-SN-083403) Avail: US Patent and Trademark Office

A system and process for on-demand generation of inert, non-flammable gases and water vapor to decrease the available atmospheric oxygen in the ullage of a hydrocarbon fuel storage tank to a level that will not support combustion of the hydrocarbon fuel, is disclosed. One, or more, of a variety of non-Halon, fire suppressor charges are selectively contained in one or more gas generating cartridges. The gas generating cartridge(s), when activated, cause release of these charges to prOmote rapid chemical reactions and supply inert, non-flammable gases and water vapor to the tank ullage. Activation is accomplished in aircraft by either pilot action or by pressure and temperature sensors contained within the hydrocarbon fuel tank.
DTIC

*Aircraft Safety; Cartridges; Chemical Reactions; Fire Extinguishers; Fire Fighting; Fire Prevention; Fuel Tanks; Hydrocarbon Fuels; Rare Gases; Storage Tanks;*

**N96-18079*#** Michigan Univ., Ann Arbor, MI. Dept. of Aerospace Engineering.

**Adaptive unstructured triangular mesh generation and flow solvers for the Navier-Stokes equations at high Reynolds number c34**

Ashford, Gregory A.; and Powell, Kenneth G.; In NASA. Langley Research Center, ICASE/LaRC Workshop on Adaptive Grid Methods 1 Oct. 1995 p 139-151 Sponsored in cooperation with IBM (For primary document see N96-18071 05-34) Avail: CASI HC A03/MF A03

A method for generating high quality unstructured triangular grids for high Reynolds number Navier-Stokes calculations about complex geometries is described. Careful attention is paid in the mesh generation process to resolving efficiently the disparate length scales which arise in these flows. First the surface mesh is constructed in a way which

ensures that the geometry is faithfully represented. The volume mesh generation then proceeds in two phases thus allowing the viscous and inviscid regions of the flow to be meshed optimally. A solution-adaptive remeshing procedure which allows the mesh to adapt itself to flow features is also described. The procedure for tracking wakes and refinement criteria appropriate for shock detection are described. Although at present it has only been implemented in two dimensions, the grid generation process has been designed with the extension to three dimensions in mind. An implicit, higher-order, upwind method is also presented for computing compressible turbulent flows on these meshes. Two recently developed one-equation turbulence models have been implemented to simulate the effects of the fluid turbulence. Results for flow about a RAE 2822 airfoil and a Douglas three-element airfoil are presented which clearly show the improved resolution obtainable.
Author
*Computational Fluid Dynamics; Grid Generation (mathematics); High Reynolds Number; Navier-stokes Equation; Shock Waves; Unstructured Grids (mathematics); Wakes;*

**N96-18084*#** Texas Univ., Austin, TX. Dept. of Aerospace Engineering and Engineering Mechanics.
**Methods for prismatic/tetrahedral grid generation and adaptation c34**
Kallinderis, Y.; In NASA. Langley Research Center, ICASE/LaRC Workshop on Adaptive Grid Methods 1 Oct. 1995 p 201-210 Prepared in cooperation with Department of Energy, Washington, DC, and Texas Univ., Austin, TX (For primary document see N96-18071 05-34)
Contract(s)/Grant(s): (NAG1-1459; NSF ASC-93-57677; ATP-003658-413) Avail: CASI HC A02/MF A03

The present work involves generation of hybrid prismatic/tetrahedral grids for complex 3-D geometries including multi-body domains. The prisms cover the region close to each body's surface, while tetrahedra are created elsewhere. Two developments are presented for hybrid grid generation around complex 3-D geometries. The first is a new octree/advancing front type of method for generation of the tetrahedra of the hybrid mesh. The main feature of the present advancing front tetrahedra generator that is different from previous such methods is that it does not require the creation of a background mesh by the user for the determination of the grid-spacing and stretching parameters. These are determined via an automatically generated octree. The second development is a method for treating the narrow gaps in between different bodies in a multiply-connected domain. This method is applied to a two-element wing case. A High Speed Civil Transport (HSCT) type of aircraft geometry is considered. The generated hybrid grid required only 170 K tetrahedra instead of an estimated two million had a tetrahedral mesh been used in the prisms region as well. A solution adaptive scheme for viscous computations on hybrid grids is also presented. A hybrid grid adaptation scheme that employs both h-refinement and redistribution strategies is developed to provide optimum meshes for viscous flow computations. Grid refinement is a dual adaptation scheme that couples 3-D, isotropic division of tetrahedra and 2-D, directional division of prisms.
Author
*Algorithms; Computational Fluid Dynamics; Computational Grids; Grid Generation (mathematics); Viscous Flow;*

**N96-18085*#** Vigyan Research Associates, Inc., Hampton, VA.
**An adaptive remeshing scheme for vortex dominated flows using three-dimensional unstructured grids c34**
Parikh, Paresh; In NASA. Langley Research Center, ICASE/LaRC Workshop on Adaptive Grid Methods 1 Oct. 1995 p 211-217 (For primary document see N96-18071 05-34)
Contract(s)/Grant(s): (NAS1-19672) Avail: CASI HC A02/MF A03

An adaptive remeshing procedure for vortex dominated flows is described, which uses three-dimensional unstructured grids. Surface grid adaptation is achieved using the static pressure as an adaptation parameter, while entropy is used in the field to accurately identify high vorticity regions. An emphasis has been placed in making the scheme as automatic as possible so that a minimum user interaction is required between remeshing cycles. Adapted flow solutions are obtained on two sharp-edged configurations at low speed, high angle-of-attack flow conditions. The results thus obtained are compared with fine grid CFD solutions and experimental data, and conclusions are drawn as to the efficiency of the adaptive procedure.
Author
*Angle of Attack; Computational Fluid Dynamics; Entropy; Flow Distribution; Grid Generation (mathematics); Static Pressure; Unstructured Grids (mathematics); Vortices;*

**N96-18086*#** Cray Research Switzerland S.A., Lausanne (Switzerland).
**Auto-adaptive finite element meshes c34**
Richter, Roland; and Leyland, Penelope; In NASA. Langley Research Center, ICASE/LaRC Workshop on Adaptive Grid Methods 1 Oct. 1995 p 219-232 (For primary document see N96-18071 05-34) Avail: CASI HC A03/MF A03

Accurate capturing of discontinuities within compressible flow computations is achieved by coupling a suitable solver with an automatic adaptive mesh algorithm for unstructured triangular meshes. The mesh adaptation procedures developed rely on non-hierarchical dynamical local refinement/derefinement techniques, which hence enable structural optimization as well as geometrical optimization. The methods described are applied for a number of the

ICASE test cases are particularly interesting for unsteady flow simulations.
Author
*Algorithms; Compressible Flow; Computational Fluid Dynamics; Euler Equations of Motion; Finite Element Method; Unsteady Flow; Unstructured Grids (mathematics);*

**N96-18087*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**Adaptive mesh refinement in curvilinear body-fitted grid systems c34**
Steinthorsson, Erlendur; Modiano, David; and Colella, Phillip; (California Univ., Berkeley, CA.) In NASA. Langley Research Center, ICASE/LaRC Workshop on Adaptive Grid Methods 1 Oct. 1995 p 233-240 (For primary document see N96-18071 05-34) Avail: CASI HC A02/MF A03

To be truly compatible with structured grids, an AMR algorithm should employ a block structure for the refined grids to allow flow solvers to take advantage of the strengths of unstructured grid systems, such as efficient solution algorithms for implicit discretizations and multigrid schemes. One such algorithm, the AMR algorithm of Berger and Colella, has been applied to and adapted for use with body-fitted structured grid systems. Results are presented for a transonic flow over a NACA0012 airfoil (AGARD-03 test case) and a reflection of a shock over a double wedge.
Author
*Algorithms; Grid Generation (mathematics); Structured Grids (mathematics);*

**N96-18113#** Lawrence Livermore National Lab., Livermore, CA.
**Progress in sub-grid scale modeling of shock-turbulence interaction**
Buckingham, A. C.; and Grun, J.; Dec. 1994 11 p
Contract(s)/Grant(s): (W-7405-ENG-48)
Report No.(s): (DE95-017859; UCRL-ID-119453) Avail: CASI HC A03/MF A01

The authors report on progress in the development of sub-grid scale (SGS) closure relationships for the unresolved motion scales in compressible large eddy simulations (LES). At present they are refining the SGS model and overall LES procedure to include: a linearized viscoelastic model for finite thickness shock distortions and shocked turbulence field response; multiple scale asymptotic considerations to improve predictions of average near-wall surface behavior; and a spectral statistical model simulating the effects of high wave number stochastic feed-back from the unresolved SGS nonlinear motion influences on the explicitly resolved grid scale motions. Predicted amplification levels, modal energy partition, shock translational to turbulence kinetic energy transfer, and viscoelastic spatio-temporal response of turbulence to shock interaction are examined in comparison with available experimental evidence. Supplemental hypersonic compressible turbulence experimental information is developed from sub nanosecond interval pulsed shadowgraph evidence of laser impulse generated hypervelocity shocks interacting with intense, previously developed and carefully characterized initial turbulence. Accurate description of the influence of shock-turbulence interactions is vital for predicting their influence on: Supersonic/hypersonic flow field analysis, aerodynamic design, and aerostructural materials selection. Practical applications also include interior supersonic combustion analysis and combustion chamber design. It is also the essential foundation for accurately predicting the development and evolution of flow-field generated thermal and electromagnetic radiation important to hypersonic flight vehicle survivability, detection and communication.
DOE
*Combustion Chambers; Compressible Flow; Energy Transfer; Flow Distribution; Hypersonic Flow; Kinetic Energy; Reynolds Stress; Shock Wave Interaction; Shock Waves; Supersonic Combustion; Supersonic Flow; Supersonic Transports; Turbulent Flow;*

**N96-18207#** California Univ., Irvine, CA. Dept. of Mechanical and Aerospace Engineering.
**Droplet-turbulence interactions over a wide spectral range Annual Technical Report, 1 Nov. 1993 - 31 Oct. 1994**
Sirignano, W. A.; Elghobashi, S. E.; Kim, I.; and Masoudi, M.; 30 Nov. 1994 100 p
Contract(s)/Grant(s): (F49620-93-1-0028)
Report No.(s): (AD-A299197; AFOSR-95-0607TR) Avail: CASI HC A05/MF A02

In the last year, the unsteady, three-dimensional, incompressible, viscous flow interactions between a single vortex tube advected by a uniform free stream and a spherical particle held fixed in space was investigated numerically for a range of particle Reynolds numbers between 20 and 100. Useful correlations of lift coefficient, moment coefficient, and drag coefficient with velocity fluctuation, Reynolds number, offset distance, and initial vortex size have been obtained and reported. A new mechanism based upon droplet lift has been suggested for the dispersion of sprays. Since the beginning of this year, the interactions between a pair of vortex tubes and a rigid sphere have been studied in order to generalize the findings from the previous investigation. Similar correlations for the force and moment coefficients have been found and are being reported. These correlations will be useful in predicting droplet trajectories. The investigation for the heat and mass transfer of a droplet interacting with vortex tubes is also under way. This should lead to useful correlations to predict droplet heating and vaporization in a flow with vortical fluctuations.
DTIC
*Aerodynamic Drag; Drops (liquids); Flow Characteristics;*

*Hilsch Tubes; Incompressible Flow; Lift; Spheres; Three Dimensional Flow; Unsteady Flow; Viscous Flow; Vortices;*

**N96-18229** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA.

**Simultaneous direct measurements of skin friction and heat flux in a supersonic flow Ph.D. Thesis**

Paik, Seung Woock; 1993 158 p Avail: Univ. Microfilms Order No. DA9419228

A new gage which can measure skin friction and heat flux simultaneously was designed, constructed, and tested. This gage is the combination of 8 non-nulling type skin friction balance and a heat flux microsensor. By mounting the heat flux microsensor directly on the surface of the floating element of the skin friction balance, it was possible to perform simultaneous measurements of the skin friction and the heat flux. The total thickness of the heat flux microsensor is less than 2 micrometers, so the presence of this microsensor creates negligible disruption on the thermal and the mechanical characteristics of the air flow Tests were conducted in the Virginia Tech supersonic wind tunnel. The nominal Mach number was 2.4, and Reynolds number per meter was 4.87 x 10(exp 7) with total pressure of 5.2 atm and total temperature of 300 deg K. Results of the tests showed that this new gage was quite reliable and could be used repeatably in the supersonic flow. This gage also has an active heating system inside of the cantilever beam of the skin friction balance so that the surface temperature of the floating element can be controlled as desired. With these features, the effects of a temperature mismatch between the gage surface and the surrounding wall on the measurements of the skin friction and the heat flux were investigated. An infrared radiometer was used to measure the surface temperature distributions. Without the active heating, the amount of temperature mismatch generated by the gage itself was from 2.5 deg K to 4.5 deg K. The active heating produced the temperature mismatch of 18.7 deg K. The largest temperature mismatch corresponds to the levels typically found in high heat flux cases when it is expressed in dimensionless terms. This temperature mismatch made sizable effects-a 24 percent increase in the skin friction measurement and a 580 percent increase in the heat flux measurements. These experimental results were compared with the computational results using the Computational Fluid Dynamics code GASP. The input flow conditions were obtained from the boundary layer measurements. The temperature mismatch was input by specifying the density and the pressure at each grid point on the wall. The Baldwin-Lomax algebraic turbulence model was used with the thin layer approximations. The comparison showed that the difference in the skin friction and heat flux was less than 10 percent of the measured data when the temperature mismatch was less than 8.5 deg K, but the difference was increased as the amount of the temperature mismatch increased. It is presumed that the disagreement between the measurements and the calculations was caused mainly by deficiencies in the turbulence model for this complex, developing viscous flow, because the Baldwin-Lomax model cannot account for the multiple length scale in this flow.

Dissert. Abstr.

*Air Flow; Computational Fluid Dynamics; Friction Measurement; Heat Flux; Measuring Instruments; Skin Friction; Supersonic Flow; Temperature Measurement;*

**N96-18419*#** Northrop Grumman Corp., Bethpage, NY. Advanced Technology Development Center.

**Novel composites for wing and fuselage applications Final Report, Mar. 1991 - Dec. 1993**

Sobel, L. H.; Buttitta, C.; and Suarez, J. A.; 1 Dec. 1995 39p Contract(s)/Grant(s): (NAS1-18784; RTOP 505-63-5B)

Report No.(s): (NASA-CR-198429; NAS 1.26:198429; E-10027; NIPS-96-08129) Avail: CASI HC A03/MF A01

Probabilistic predictions based on the IPACS code are presented for the material and structural response of unnotched and notched, IM6/3501-6 Gr/Ep laminates. Comparisons of predicted and measured modulus and strength distributions are given for unnotched unidirectional, cross-ply and quasi-isotropic laminates. The predicted modulus distributions were found to correlate well with the test results for all three unnotched laminates. Correlations of strength distributions for the unnotched laminates are judged good for the unidirectional laminate and fair for the cross-ply laminate, whereas the strength correlation for the quasi-isotropic laminate is judged poor because IPACS did not have a progressive failure capability at the time this work was performed. The report also presents probabilistic and structural reliability analysis predictions for the strain concentration factor (SCF) for an open-hole, quasi-isotropic laminate subjected to longitudinal tension. A special procedure was developed to adapt IPACS for the structural reliability analysis. The reliability results show the importance of identifying the most significant random variables upon which the SCF depends, and of having accurate scatter values for these variables.

Author

*Aircraft Construction Materials; Fuselages; Graphite-epoxy Composites; Laminates; Reliability Analysis; Structural Analysis; Structural Reliability; Wings;*

**N96-18518*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

**The NASA landing gear test airplane**

Carter, John F.; and Nagy, Christopher J.; (Planning Research Corp., Edwards, CA.)1 Jun. 1995 22 p Contract(s)/Grant(s): (RTOP 551-15-01)

Report No.(s): (NASA-TM-4703; NAS 1.15:4703; H-2045; NIPS-96-07731) Avail: CASI HC A03/MF A01

A tire and landing gear test facility has been developed and incorporated into a Convair 990 aircraft. The system can

simulate tire vertical load profiles to 250,000 lb, sideslip angles to 15 degrees, and wheel braking on actual runways. Onboard computers control the preprogrammed test profiles through a feedback loop and also record three axis loads, tire slip angle, and tire condition. The aircraft to date has provided tire force and wear data for the Shuttle Orbiter tire on three different runways and at east and west coast landing sites. This report discusses the role of this facility in complementing existing ground tire and landing gear test facilities, and how this facility can simultaneously simulate the vertical load, tire slip, velocity, and surface for an entire aircraft landing. A description is given of the aircraft as well as the test system. An example of a typical test sequence is presented. Data collection and reduction from this facility are discussed, as well as accuracies of calculated parameters. Validation of the facility through ground and flight tests is presented. Tests to date have shown that this facility can operate at remote sites and gather complete data sets of load, slip, and velocity on actual runway surfaces. The ground and flight tests have led to a successful validation of this test facility.
Author
*Aircraft Landing; Aircraft Tires; Flight Test Vehicles; Landing Gear; Load Tests; Test Facilities; Vehicle Wheels;*

**N96-19514*#** Washington Univ., Saint Louis, MO. Dept. of Physics.
**Application of linear array imaging techniques to the real-time inspection of airframe structures and substructures Annual Report, 15 Mar. - 31 Oct. 1995**
Miller, James G.; 31 Oct. 1995 19 p
Contract(s)/Grant(s): (NSG-1601)
Report No.(s): (NASA-CR-199978; NAS 1.26:199978; NIPS-96-07061) Avail: CASI HC A03/MF A01

Development and application of linear array imaging technologies to address specific aging-aircraft inspection issues is described. Real-time video-taped images were obtained from an unmodified commercial linear-array medical scanner of specimens constructed to simulate typical types of flaws encountered in the inspection of aircraft structures. Results suggest that information regarding the characteristics, location, and interface properties of specific types of flaws in materials and structures may be obtained from the images acquired with a linear array. Furthermore, linear array imaging may offer the advantage of being able to compare 'good' regions with 'flawed' regions simultaneously, and in real time. Real-time imaging permits the inspector to obtain image information from various views and provides the opportunity for observing the effects of introducing specific interventions. Observation of an image in real-time can offer the operator the ability to 'interact' with the inspection process, thus providing new capabilities, and perhaps, new approaches to nondestructive inspections.
Derived from text
*Airframes; Imaging Techniques; Linear Arrays; Nondestructive Tests; Ultrasonic Flaw Detection;*

## 13 GEOSCIENCES

*Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.*

**N96-17772*#** National Aeronautics and Space Administration, Washington, DC.
**The 1995 scientific assessment of the atmospheric effects of stratospheric aircraft**
Stolarski, Richard S.; Baughcum, Steven L.; Brune, William H.; Douglass, Anne R.; Fahey, David W.; Friedl, Randall R.; Liu, Shaw C.; Plumb, R. Alan; Poole, Lamont R.; and Wesoky, Howard L.; et al1 Nov. 1995 106 p
Report No.(s): (NASA-RP-1381; NAS 1.61:1381; NIPS-96-06877) Avail: CASI HC A06/MF A02

This report provides a scientific assessment of our knowledge concerning the impact of proposed high-speed civil transport (HSCT) aircraft on the atmosphere. It comes at the end of Phase 1 of the Atmospheric Effects of Stratospheric Aircraft element of the NASA High-Speed Research Program. The fundamental problem with stratospheric flight is that pollutant residence times are long because the stratosphere is a region of permanent temperature inversion with stable stratification. Using improved two-dimensional assessment models and detailed fleet emissions scenarios, the assessment examines the possible impact of the range of effluents from aircraft. Emphasis is placed on the effects of NO(x) and H2O on the atmospheric ozone content. Measurements in the plume of an in-flight Concorde supersonic transport indicated a large number of small particles. These measurements, coupled with model sensitivity studies, point out the importance of obtaining a more detailed understanding of the fate of sulfur in the HSCT exhaust. Uncertainties in the current understanding of the processes important for determining the overall effects of HSCT's on the atmosphere are discussed and partially quantified. Research directions are identified to improve the quantification of uncertainties and to reduce their magnitude.
Author
*Atmospheric Chemistry; Atmospheric Effects; Atmospheric Models; Environment Effects; Exhaust Emission; Exhaust Gases; Global Air Pollution; Jet Exhaust; Ozone Depletion; Plumes; Stratosphere; Supersonic Transports;*

**N96-17831*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**Gravity wave momentum flux in the lower stratosphere over convection**
Alexander, M. Joan; and Pfister, Leonhard; American Geophysical Union 1 Aug. 1995 4 p Repr. from Geophysical

Research Letters, v. 22, no. 15, 1 Aug. 1995 p 2029-2032
Contract(s)/Grant(s): (NAGW-662; NSF ATM-93-22480)
(ISSN 0094-8534)
Report No.(s): (NASA-CR-200038; NAS 1.26:200038; PAPER 95GL01984; NIPS-96-07290) Copyright Avail: CASI HC A01/MF A01

This work describes a method for estimating vertical fluxes of horizontal momentum carried by short horizontal scale gravity waves (lambda(sub x) = 10-100 km) using aircraft measured winds in the lower stratosphere. We utilize in situ wind vector and pressure altitude measurements provided by the Meteorological Measurement System (MMS) on board the ER-2 aircraft to compute the momentum flux vectors at the flight level above deep convection during the tropical experiment of the Stratosphere Troposphere Exchange Project (STEP-Tropical). Data from Flight 9 are presented here for illustration. The vertical flux of horizontal momentum these observations points in opposite directions on either side of the location of a strong convective updraft in the cloud shield. This property of internal gravity waves propagating from a central source compares favorably with previously described model results.
Author
*Atmospheric Circulation; Atmospheric Pressure; Flux Density; Free Convection; Gravity Waves; Momentum; Stratosphere; Vertical Air Currents; Wind Direction;*

**N96-18725*#** Harvard Univ., Cambridge, MA. Dept. of Chemistry.
**Development of techniques for the In Situ observation of OH and HO2 for studies of the impact of high-altitude supersonic aircraft on the stratosphere Final Report, 1 Aug. 1990 - 31 Jul. 1993**
Anderson, James G.; 8 Sep. 1994 4 p
Contract(s)/Grant(s): (NCC2-693)
Report No.(s): (NASA-CR-200205; NAS 1.26:200205; NIPS-96-08374) Avail: CASI HC A01/MF A01

This three-year project supported the construction, calibration, and deployment of a new instrument to measure the OH and HO2 radicals on the NASA Er-2 aircraft. The instrument has met and exceeded all of its design goals. The instrumentation represents a true quantum leap in performance over that achieved in previous HO(x) instruments built in our group. Sensitivity of OH was enhanced by over two orders of magnitude as the weight fell from approximately 1500 to less than 200 Kg. Reliability has been very high: HO(x) data are available for all flights during the first operational mission, the Stratospheric Photochemistry, aerosols, and Dynamics Expedition (SPADE). The results of that experiment have been reported in the scientific literature and at conferences. Additionally, measurements of H2O and O3 were made and have been reported in the scientific literature. The measurements demonstrate the important role that OH and HO2 play in determining the concentration of ozone in the lower stratosphere. During the SPADE campaign, the measurements demonstrate that the catalytic removal is dominated by processes involving the odd-hydrogen and halogen radicals-an extremely important constraint for photochemical models that are being used to assess the potential deleterious effects of super-sonic aircraft effluent on the burden of stratospheric ozone.
Derived from text
*Aerosols; Air Sampling; Airborne Equipment; Atmospheric Composition; Concentration (composition); Fabrication; Hydroxyl Radicals; In Situ Measurement; Peroxides; Stratosphere;*

**N96-19053*#** McDonnell-Douglas Aerospace, Long Beach, CA. Traffic Aircraft.
**Jet aircraft engine emissions database development: 1992 military, charter, and nonscheduled traffic**
Metwally, Munir; 1 Nov. 1995 61 p
Contract(s)/Grant(s): (NAS1-19345; RTOP 538-08-12-01)
Report No.(s): (NASA-CR-4684; NAS 1.26:4684; CRAD-9103-TR-9914; NIPS-96-08514) Avail: CASI HC A04/MF A01

Studies relating to environmental emissions database for the military, charter, and non-scheduled traffic for the year 1992 were conducted by McDonnell Douglas Aerospace Transport Aircraft. The report also includes a comparison with a previous emission database for year 1990. Discussions of the methodology used in formulating these databases are provided.
Author
*Aircraft Engines; Atmospheric Effects; Data Bases; Environment Effects; Environment Pollution; Exhaust Emission; Jet Aircraft;*

**N96-19232#** General Accounting Office, Washington, DC. Resource, Community and Economic Development Div.
**Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives. Air pollution: FAA's reliance on manufacturers for jet engine emission testing**
13 Jul. 1994 14 p
Report No.(s): (GAO/RCED-94-99; B-256004) Avail: CASI HC A03/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

Because FAA relies on the jet engine manufacturers and on its designees (engineers who are employees of these companies and who represent FAA) for emission testing, concerns exist on (1) how FAA ensures that jet aircraft engines meet emission standards and (2) what steps FAA and the manufacturers have taken to address the potential for conflict of interest in the designee system. While the FAA reviews and approves test plans and results, it seldom, if ever, observes the manufacturers conducting such tests. FAA officials believe that because compliance with emission stan-

dards is determined by sampling exhaust emissions and performing analytical calculations, there would be little value in FAA's observing the tests conducted at the manufacturers' facilities. FAA and the manufacturers have taken several steps intended to buffer designees from pressures that could compromise their oversight role. FAA has a policy of appointing as designees manufacturer employees who have sufficient authority within the company to resist possible pressures to bypass FAA's requirements. Also, the manufacturers have aligned their organizational structure so that designees report to managers who are not directly responsible for designing and developing engines.
CASI
*Air Pollution; Aircraft Engines; Aircraft Industry; Congressional Reports; Engine Tests; Exhaust Emission; Jet Engines;*

## 14 LIFE SCIENCES

*Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.*

No abstracts in this category.

## 15 MATHEMATICAL AND COMPUTER SCIENCES

*Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.*

**N96-17809*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**X based interactive computer graphics applications for aerodynamic design and education**
Benson, Thomas J.; and Higgs, III, C. Fred; (Rensselaer Polytechnic Inst., Troy, NY.)1 Dec. 1995 10 p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1995; sponsored by AIAA
Contract(s)/Grant(s): (RTOP 505-62-52)
Report No.(s): (NASA-TM-107128; NAS 1.15:107128; E-10052; AIAA PAPER 96-0049; NIPS-96-07530) Avail: CASI HC A02/MF A01

Six computer applications packages have been developed to solve a variety of aerodynamic problems in an interactive environment on a single workstation. The packages perform classical one dimensional analysis under the control of a graphical user interface and can be used for preliminary design or educational purposes. The programs were originally developed on a Silicon Graphics workstation and used the GL version of the FORMS library as the graphical user interface. These programs have recently been converted to the XFORMS library of X based graphics widgets and have been tested on SGI, IBM, Sun, HP and PC-Lunix computers. The paper will show results from the new VU-DUCT program as a prime example. VU-DUCT has been developed as an educational package for the study of subsonic open and closed loop wind tunnels.
Author
*Aerodynamics; Computer Graphics; Design Analysis; Dimensional Analysis; Graphical User Interface;*

**N96-18527#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
**Knowledge-Based Functions in Aerospace Systems [Systemes de Guidage et de Pilotage Aerospatiaux a Base de Systemes Experts]**
1 Nov. 1995 150 p Lecture series held in Madrid, Spain, 6-7 Nov. 1995; Chatillon, France, 9-11 Nov. 1995; Moffett Field, CA, United States, 16-17 Nov. 1995
Report No.(s): (AGARD-LS-200; ISBN-92-836-1026-1; NIPS-96-07993) Avail: CASI HC A07/MF A02

In aerospace systems classical control technology has enabled the transfer of functions of the human operator to machines which need not be based on the explicit evaluation of knowledge. Symbolic data processing, neural networks and the techniques of artificial intelligence now permit the design of automatic systems which can explicity make use of knowledge stored in computers. The Lecture Series presents a conceptual framework for the automation of knowledge-based control and management functions in aerospace systems, which are usually carried out by human operators. It describes the structure of these functions, discusses successful examples of application and gives recommendations for further studies. For individual titles, see N96-18528 through N96-18533.
*Aerospace Systems; Air Traffic Control; Automatic Control; Conferences; Control Systems Design; Expert Systems; Flight Control; Knowledge Bases (artificial Intelligence);*

**N96-18767#** Iowa Univ., Iowa City, IA.
**The fluid mechanics of vortex cutting by a blade Final Report, 1 Aug. 1992 - 31 Jul. 1995**
Marshall, Jeffrey S.; 24 Sep. 1995 39 p
Contract(s)/Grant(s): (DAAH04-93-G-0378)
Report No.(s): (AD-A300023; ARO-32300.7-EG-YIP) Avail: CASI HC A03/MF A01

A study of the fluid dynamics associated with impact of a vortex on a body (such as a blade) moving normal to the vortex axis was performed. The physical features of the flow evolution were categorized in terms of two dimensionless parameters, which represent a ratio of length scales and a ratio of velocity scales associated with the vortex core and with the body. Models of various features of the flow evolution are constructed and compared against experimental and detailed computational data. Primary features of interest in the study

include vortex deflection and axial flow in the vortex core resulting from stretching by the blade, intense vorticity deformation resulting from penetration of the body into the vortex core (and resulting force on the body), traveling vortex breakdown formed immediately following vortex cutting by the body, and interaction of shed vorticity from the body with the primary vortex.
DTIC
*Axial Flow; Gas-solid Interactions; Inviscid Flow; Rotary Wings; Rotor Blades; Rotor Body Interactions; Tail Rotors; Viscous Flow; Vortex Shedding; Vortices;*

**N96-18889#** Air Force Inst. of Tech., Wright-Patterson AFB, OH. National Air Intelligence Center.
**Aircraft drawing-die design CAD expert system based on engineering graph.**
Fu, Xiangyang; Gao, Guangdao; and Yang, Peng; 21 Aug. 1995 14 p Transl. into ENGLISH from Acta Aeronautica et Astronautica Sinica (China), v. 15, no. 10, Oct. 1994
Report No.(s): (AD-A300179; NAIC-ID(RS)T-0374-95) Avail: CASI HC A03/MF A01

The features of engineering CAD expert systems are discussed and an ADDES system Aircraft Drawing-Die Design CAD Expert System) is built. Based on the construction of the DIE coding system, such methods as the feature-based code system are used to establish a customer model. The agents in the system have the ability to solve partial problems, and the system is organized into distributed and hierarchical forms. The system synthetically utilizes blackboard structure, meta-reasoning and so on to control the problem solving process. As discussed above, the problems such as low efficiency etc caused by building a large knowledge base can be solved and the cooperation of many experts can be attained.
DTIC
*Aircraft Design; Aircraft Models; Computer Aided Design; Expert Systems; Knowledge Based Systems; Systems Engineering;*

**N96-19516*#** Georgia Inst. of Tech., Atlanta, GA.
**NASA Multidisciplinary Design and Analysis Fellowship Program Interim Report, Jan. - Sep. 1995**
Schrage, D. P.; 1 Nov. 1995 22 p
Contract(s)/Grant(s): (NGT-10007)
Report No.(s): (NASA-CR-199977; NAS 1.26:199977; NIPS-96-07062) Avail: CASI HC A03/MF A01

This report is a Year 1 interim report of the progress on the NASA multidisciplinary Design and Analysis Fellowship Program covering the period, January 1, 1995 through September 30, 1995. It summarizes progress in establishing the MDA Fellowship Program at Georgia Tech during the initial year. Progress in the advertisement of the program, recruiting results for the 1995-96 academic year, placement of the Fellows in industry during Summer 1995, program development at the M.S. and Ph.D. levels, and collaboration and dissemination of results are summarized in this report. Further details of the first year's progress will be included in the report from the Year 1 Workshop to be held at NASA Langley on December 7-8, 1995.
Derived from text
*Aerospace Engineering; Aerospace Industry; Aerospace Sciences; Education; Georgia; Multidisciplinary Design Optimization; Multidisciplinary Research; Research Facilities; University Program;*

## 16 PHYSICS

*Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.*

**N96-19068*#** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Fiber and Electro-Optics Research Center.
**Optical fiber sensors for damage analysis in aerospace materials Final Report, 1 Aug. 1993 - 31 Dec. 1995**
Schindler, Paul; May, Russell; and Claus, Richard; 31 Dec. 1995 64 p
Contract(s)/Grant(s): (NAG1-1508)
Report No.(s): (NASA-CR-199981; NAS 1.26:199981; NIPS-96-07042) Avail: CASI HC A04/MF A01

Under this grant, fiber optic sensors were investigated for use in the nondestructive evaluation of aging aircraft. Specifically, optical fiber sensors for detection and location of impacts on a surface, and for detection of corrosion in metals were developed. The use of neural networks was investigated for determining impact location by processing the output of a network of fiberoptic strain sensors distributed on a surface. This approach employs triangulation to determine location by comparing the arrival times at several sensors, of the acoustic signal generated by the impact. For this study, a neural network simulator running on a personal computer was used to train a network using a back-propagation algorithm. Fiber optic extrinsic Fabry-Perot interferometer (EFPI) strain sensors are attached to or embedded in the surface, so that stress waves emanating from an impact can be detected. The ability of the network to determine impact location by time-or-arrival of acoustic signals was assessed by comparing network outputs with actual experimental results using impacts on a panel instrumented with optical fiber sensors. Using the neural network to process the sensor outputs, the impact location can be inferred to centimeter range accuracy directly from the arrival time data. In addition, the network can be trained to determine impact location, regardless of material anisotropy. Results demonstrate that a back-propagation network identifies impact location for an anisotropic graphite/bismaleimide plate with the same accuracy as that for an isotropic aluminum plate. Two different ap-

proaches were investigated for the development of fiber optic sensors for corrosion detection in metals, both utilizing optical fiber sensors with metal coatings. In the first approach, an extrinsic Fabry-Perot interferometric fiber optic strain sensor was placed under tensile stress, and while in the resulting strained position, a thick coating of metal was applied. Due to an increase in the quantity of material, the sensor does not return to its original position upon removal of the applied stress, and some residual strain is maintained within the sensor element. As the metal thickness decreases due to corrosion, this strain is released, providing the sensing mechanism for corrosion detection. In the second approach, photosensitive optical fibers with long period Bragg gratings in the core were coated with metal. The Bragg gratings serve to couple core modes at discrete wavelengths to cladding modes. Since cladding modes interact with the metal coating surrounding the fiber cladding, the specific wavelengths coupled from core to cladding depend on the refractive index of the metal coating. Therefore, as the metal corrodes, the resulting change in index of the coating may be measured by measuring the change in wavelength of the coupled mode. Results demonstrate that both approaches can be successfully used to track the loss in metal coating on the optical fiber sensors due to corrosion.
Derived from text
*Aircraft Construction Materials; Aircraft Maintenance; Damage Assessment; Electronic Equipment Tests; Fabry-perot Interferometers; Fiber Optics; Impact Damage; Metal Coatings; Neural Nets; Nondestructive Tests; Optical Fibers; Signal Detection; Strain Gages; Tensile Stress;*

**N96-19675#** Kansas State Univ., Manhattan, KS. Dept. of Physics.
**Atomic physics with highly charged ions Progress Report, 1 Sep. 1994 - 31 Aug. 1995**
Richard, Patrick; Sep. 1995 6 p
Contract(s)/Grant(s): (DE-FG02-94ER-14444)
Report No.(s): (DE95-017586; DOE/ER-14444/1) Avail: CASI HC A02/MF A01

Grant DE-FG02-94ER14444 was obtained from the FY94 ARIM fund account of Energy Research. These funds were requested to address several upgrades of the MacDonald Laboratory facility. The largest item is the relocation and upgrade of the He compressor associated with providing LHe to the Nb split-ring superconducting LINAC accelerator and the superconducting CRYEBIS ion source. The move is prompted by the need to reduce the noise and vibration levels in the personnel working space in the laboratory. Several other issues related to the relocation are being addressed at the same time, such as additional electrical service and overhead crane for compressor maintenance. The Ion-Compressor Relocation Project consists of six major components. All necessary planning and engineering are completed. Many of the upgrades consist of obtaining commercially available items which are being installed by our local staff in the Macdonald Laboratory. No unexpected complications stand in the way of completing all projects within the scope, budget and time frame of the project. Of the project's major components, the tandem resistor upgrade, tandem foil stripper upgrade, and LINAC upgrade are all complete, the CRYEBIS upgrade is partially completed and on schedule, the LHe compressor upgrade is in the early stages of development and is on schedule, and the RF electronics upgrade is in progress. (The LINAC upgrade replaces the beam scanner item).
DOE
*Atomic Physics; Energy Technology; Ion Sources; Laboratory Equipment; Linear Accelerators; Research Facilities;*

## 17 SOCIAL SCIENCES

*Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.*

No abstracts in this category.

## 18 SPACE SCIENCES

*Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.*

**N96-19659#** Environmental Protection Agency, Washington, DC.
**Emerging technology report: Preliminary status of airplane deicing fluid recovery systems**
Sep. 1995 54 p
Report No.(s): (PB95-270724; EPA/832/B-95/005) Avail: CASI HC A04/MF A01

This document presents the results of a preliminary technical evaluation of commercially available ADF recovery processes. It explores design-related questions, identifying weakness or limitations, provide cost data and are beneficial in the investigation of operation and maintenance problems. In addition, the results of the preliminary evaluation identifies a specific range of conditions under which the process or technology demonstrates levels of performance efficiency. This preliminary technology evaluation is an essential first step in disseminating actual data on selected process or techniques. This report is not intended to establish ADF recovery systems as the preferred approach no preclude other systems or methods for the control of ADF or ADF contaminated storm water.
NTIS
*Aircraft Icing; Contamination; Deicers; Environment Effects; Identifying; Materials Recovery; Water Runoff;*

## 19 GENERAL

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## D



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## F



## G



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## I

## T



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Avail: Fachinformationszentrum Karlsruhe. Gesellschaft für wissenschaftlich-technische Information mbH 76344 Eggenstein-Leopoldshafen, Germany.

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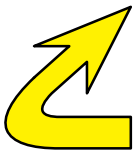

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